10-26-04

AF/IEW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Scott J. TUMAN et al.

Group Art Unit: 1762

Serial No.: 09/822,651

Examiner: Elena Tsoy

Confirmation No.: 9447

Filed: 30 March 2001

Docket No.: 54407US006
(formerly 54407USA6B.006)

Title: WEB HAVING DISCRETE STEM REGIONS

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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Fee Calculation for Claims Pending After Amendment					
	Pending Claims after Amendment (1)	Claims Paid for Earlier (2)	Number of Additional Claims (1-2)	Cost per Additional Claim	Additional Fees Required
Total Claims				x $18 =	
Independent Claims				x $88 =	
One or More New Multiple Dependent Claims Presented? If Yes, Add $300 Here →					
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PATENT
Docket No. 54407US006

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant(s):	Scott J. TUMAN et al.	Group Art Unit:	1762
Serial No.:	09/822,651	Examiner:	Elena Tsoy
Confirmation No.:	9447		
Filed:	30 March 2001		
For:	WEB HAVING DISCRETE STEM REGIONS		

APPELLANTS' BRIEF ON APPEAL

Commissioner for Patents
Mail Stop Appeal Brief - Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Brief is presented in support of the Appeal filed 24 May 2004, from the final rejection of claims 21-48 and 50-70 of the above-identified application under 37 C.F.R. §§1.113 and 1.191.

This Brief is being submitted as set forth in 37 C.F.R. § 1.192(a). Please charge Deposit Account No. 13-4895 the fee for filing this Brief under 37 C.F.R. § 1.17(f).

I. REAL PARTY IN INTEREST

The real party in interest of the above-identified patent application is the assignee, 3M Innovative Properties Company.

II. RELATED PRIOR AND PENDING APPEALS, INTERFERENCES OR JUDICIAL PROCEEDINGS

There are no appeals, interferences, or judicial proceedings known to Appellants' Representatives which would directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 21-48 and 50-70 are rejected and are the subject of this Appeal (see Appendix I). Claims 1-20 and 49 have been canceled.

IV. STATUS OF AMENDMENTS

No amendments have been presented after issuance of the Final Office Action on 23 December 2003.

V. SUMMARY OF CLAIMED SUBJECT MATTER

For the purposes of this appeal, a concise explanation of the subject matter defined in each of the independent claims involved in this appeal is provided below. These explanations are not intended and should not be used to limit the scope of the claims.

Claim 21: A Web Construction

With reference to Figures 1, 3, and 4, claim 21 recites a web construction that includes a web (10) coextensive with the web construction, wherein the web (10) includes two opposing sides (18 & 19) and an indefinite length. A plurality of discrete polymeric regions (14) are fused to a first major side (18) of the web (10). A plurality of stems (12) extend from each discrete polymeric region (14). *See, e.g.,* Specification, p. 2, lines 2-26; and p. 4, lines 19-29.

Claim 40: A Web Construction

Claim 40 recites a web construction that includes an elastic web (10) coextensive with the web construction. *See, e.g.,* Specification, p. 5, lines 28-31; and p. 11, line 5 to p. 13, line 24, as well as Figures 1, 3, and 4. A plurality of discrete polymeric regions (14) are fused to a first major side (18) of the web (10). A plurality of stems (12) extend from each discrete polymeric region (14). *See, e.g.,* Specification, p. 2, lines 2-26; and p. 4, lines 19-29. The web (10) defines a localized plane and the stems (12) are oriented at an angle that is not normal to the localized plane. *See, e.g.,* Specification, p. 2, lines 8-13; p. 5, lines 1-2; p. 7, lines 1-21; p. 10, lines 18-22; and Figure 8.

Claim 48: A Web Construction

Claim 48 recites a web construction that includes an elastic web (10) coextensive with the web construction, the elastic web including loop structures. *See, e.g.,* Specification, p. 2, lines 24-26; p. 5, lines 17-22 & 28-31; and p. 11, line 5 to p. 13, line 24. A plurality of discrete polymeric regions (14) are fused to a first major side (18) of the web (10). A plurality of stems (12) extend from each discrete polymeric region (14). *See, e.g.,* Specification, p. 2, lines 2-26; and p. 4, lines 19-29. The stems (12) are adapted to lock with the loop structures of the web (10). *See, e.g.,* Specification, p. 2, lines 24-26 and p. 5, lines 21-22.

Claim 56: A Mechanical Fastener

Claim 56 recites a mechanical fastener that includes a nonwoven web (10) with at least one discrete polymeric region (14) fused to one major side (18) of the nonwoven web. Specification, p. 2, lines 2-26, p. 4, lines 16 to p. 5, line 2. A plurality of discrete polymeric regions (14) are fused to a first major side (18) of the web (10). A plurality of stems (12) extend from each discrete polymeric region (14). *See, e.g.,* Specification, p. 2, lines 2-26; and p. 4, lines

19-29. The polymer of the at least one discrete polymeric region (14) is entangled with a fibrous surface of the web (10). *See, e.g.,* Specification, Example 13, p. 17, line 30 to p. 18, line 15.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Whether claims 21-31, 33-35, 37, 39, 40, 42-48, 50-53, and 55 are patentable under 35 U.S.C. §102(b) as anticipated by Thomas (U.S. Patent No. 5,586,371).

B. Whether claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 are patentable under 35 U.S.C. §102(b) as anticipated by Wessels et al. (U.S. Patent No. 5,669,120).

C. Whether claims 32, 41, and 54 are patentable under 35 U.S.C. §103(a) over Thomas (U.S. Patent No. 5,586,371) in view of Murasaki (U.S. Patent No. 5,643,651).

D. Whether claim 36 is patentable under 35 U.S.C. §103(a) over Thomas (U.S. Patent No. 5,586,371).

E. Whether claim 38 is patentable under 35 U.S. C. §103(a) over Thomas (U.S. Patent No. 5,586,371) in view of Shephard et al. (U.S. Patent No. 6,205,623).

F. Whether claims 32, 41, and 54 are patentable under 35 U.S.C. 103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Murasaki (U.S. Patent No. 5,643,651).

G. Whether claims 34-37 are patentable under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120).

H. Whether claims 40, 42-48, 50-53, 55, 56, and 58-70 are patentable under 35 U.S.C. 103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Allen et al. (U.S. Patent No. 5,547,531).

VII. ARGUMENT

A. Claims 21-31, 33-35, 37, 39, 40, 42-48, 50-53, and 55 are patentable over Thomas (U.S. Patent No. 5,586,371) under 35 U.S.C. § 102(b).

Claims 21-31, 33-35, 37, 39, 40, 42-48, 50-53, and 55 stand rejected under 35 U.S.C. §102(b) over Thomas (U.S. Patent No. 5,586,371). Appellants respectfully disagree and request review and reversal of this rejection by the Board.

Appellants submit that claims 21-31, 33-35, 37, 39-40, 42-53 and 55 are not anticipated by Thomas because Thomas does not teach each and every element of the rejected claims. For a claim to be anticipated under 35 U.S.C. § 102(b), each and every element of the claim must be found in a single prior art reference. Anticipation requires that a single reference contain all of the elements of the claims at issue and that the elements be disclosed in the combinations recited by the claims. *See, e.g., Shearing v. Iolab Corp.*, 975 F.2d 1541, 1544-1545, 24 USPQ2d 1133, 1136 (Fed. Cir. 1992); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989), *cert. denied*, 493 US 853 (1989); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 894, 221 USPQ 669, 673 (Fed. Cir. 1984), *cert. denied*, 469 US 857 (1984).

Each of the independent claims subject to this rejection (i.e., claims 21, 40, and 48) recites a plurality of discrete polymeric regions fused to a first major side of the web. A plurality of stems extends from each discrete polymeric region of the plurality of polymeric regions.

In contrast to claims 21, 40, and 48, the Examiner has identified, within the disclosure of Thomas, an array of loops 22 attached to a substrate 24. Each individual loop is attached to the substrate 24 by a base 26. In other words, the identified portions of Thomas show that each "discrete polymeric region" provides only a single loop.

Nonetheless, the Examiner asserts that a row of loop components in Thomas equates to a "discrete polymeric portion." Even if, for the sake of argument, one were to consider a row of adjacent loop components the equivalent of the claimed discrete polymeric regions, the loop

components form only loops, not stems. That is, each loop is "severed from the distal end 30" (see Figure 1) where it then engages the adjacent loop while molten and forms the "solid loop structure 22." *See, e.g., Thomas*, col. 5, line 59 - col. 6, line 8. Thus, Thomas does not disclose any "stems" in the loop structure 22.

In the Advisory Action dated May 18, 2004, the Examiner asserted that the "word 'stem' can be interpreted according to Merriam Webster's Collegiate Dictionary, as 'something held to resemble a plant stem', loop stems 28 clearly cover claimed stems." *Advisory Action*, pp. 2-3 (May 18, 2004). This new definition of "stem" was presented in an attempt to address Appellants' arguments. Appellants disagree with this assertion by the Examiner.

Moreover, Appellants note that the newly offered definition of "stem" is inconsistent with a position taken earlier by the Examiner. In the Final Office Action, the Examiner asserted that "[t]he Office Action does not equate the loops of Thomas with stems. Each loop or hook in Thomas has a base portion, a stem portion and upper portion." In other words, the Examiner previously asserted that the loops of Thomas include a "stem portion," but now asserts that the loops are themselves "stems."

In fact, Thomas itself does not describe the loops as "stems" or as having "stem portions" as asserted by the Examiner in the two conflicting interpretations of Thomas. Rather, the term "stem" is used by Thomas only in connection with hooks, not loops. The conflicting interpretations of the teachings of Thomas as offered by the Examiner in support oft this rejection only serve to emphasize Appellants' position, i.e., that this rejection is not supported by Thomas and that a proper case of anticipation has not been established.

Another assertion presented earlier in support of this rejection relates to the differentiation between "shanks" and "stems" in Thomas. In the Final Office Action, the Examiner asserted that Thomas teaches that "... **shanks** are **stems** (See column 4, line 53). . . ." Final Office Action, p. 5 (December 23, 2003) (emphasis in original). A close review of the

cited passage reveals that Thomas actually equates shanks and stems only with respect to the formation of hooks, not loops. The Examiner, however, relied on this passage relating to hooks in combination with the teachings of Thomas with respect to loops. The hook structures disclosed by Thomas are, however, limited to one hook per base and the Examiner has admitted that the "hook structures 44 do not form claimed 'discrete polymeric regions'." Advisory Action, p. 2 (May 18, 2004).

In other words, the Examiner's assertions in support of this anticipation rejection mix and match various features of the hook and loop structures in combinations that are not taught by Thomas. Anticipation, however, requires that a single reference contain all of the elements of the claims at issue and that the elements be disclosed in the combinations recited by the claims. *See, e.g., Shearing v. Iolab Corp.*, 975 F.2d 1541, 1544-1545, 24 USPQ2d 1133, 1136 (Fed. Cir. 1992); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989*), cert. denied*, 493 US 853 (1989); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 894, 221 USPQ 669, 673 (Fed. Cir. 1984), *cert. denied*, 469 US 857 (1984).

The Examiner has also asserted, in support of this rejection, that Thomas teaches a plurality of "discrete arrays (polymeric regions)" that are "deposited in a liquid state and pressed to a substrate 24 by a backing roll 62, i.e., fused to the substrate . . . ." Office Action, p. 5 (December 23, 2003) (emphasis in original). The Examiner also asserted that Thomas teaches fusing a polymeric material to a substrate because "Thomas also deposits a polymeric material on a substrate 24 in a **liquid** (molten) state and presses into cavities by a roll 62 (See Fig. 5; column 5, lines 36-58)." Office Action, p. 5 (December 23, 2003) (emphasis in original). Appellants respectfully disagree.

The actual transfer of polymer as taught by Thomas is described as "... a manufacturing process which is similar to a process commonly known as rotary screen printing...." Thomas, col. 5, lines 29-31. The backing roll 62 does not press the polymer to the substrate as asserted in

the Office Action. Rather, the backing roll 62 holds the substrate against the print cylinder 60 while polymer is extruded through apertures 56 in the print cylinder 60 onto the surface of the substrate 24. The following excerpt from Thomas describes transfer of the polymer to the substrate in more detail:

> The second roll, referred to as the backing roll 62, provides the reaction against the print cylinder 60 to position the substrate 24 against the print cylinder 60 as the substrate 24 passes through the nip 58. Liquid, thermally sensitive material, preferably thermoplastic material, from which the loops 22 are eventually formed is supplied from a heated source, such as a heated pressure bar 72. The thermally sensitive material is forced into the apertures 56 by a doctor blade 74 as the print cylinder 60 is rotated about its centerline. The thermally sensitive material is then extruded from the apertures 56 onto the substrate 24 in the desired pattern.
> Thomas, col. 5, lines 48-58.

In other words, Thomas does not teach (or suggest) that the backing roll 62 press the polymer to the substrate 24 as asserted in support of this rejection and such assertions cannot be used to support this anticipation rejection.

Further, Appellants disagree with the assertion that Thomas teaches polymeric regions that are "fused" to a substrate to a degree that supports an anticipation rejection. Thomas does not explicitly teach that the polymeric materials are "fused" to the substrate, but rather teaches only that the bases of the loops or hooks are "deposited" on the substrate. As such, the assertion that the bases of the hooks or loops of Thomas are fused to the substrate is based on inherency, i.e., that Thomas inherently teaches fused polymeric regions.

The standard for inherency with respect to anticipation, however, requires that the asserted result (i.e., fused polymeric regions) must necessarily result from the process disclosed in Thomas. "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). *See also, In re Robertson,* 169 F.3d 743,

745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) ("Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.") Appellants respectfully submit that the burden of establishing anticipation through inherency has not been met in the present rejection.

Appellants respectfully submit that claims 22-31, 33-35, 37, 39, 42-47, 50-53, and 55, which depend from one of independent claims 21, 40, and 48, are not anticipated by Thomas for the same reasons as presented above for claims 21, 40, and 48. In addition, such dependent claims each recite additional elements that further support patentability when combined with their respective independent claims.

For at least the above reasons, Appellants submit that claims 21-31, 33-35, 37, 39-40, 42-48, 50-53, and 55 are not anticipated by Thomas. Review and reversal of this rejection by the Board are, therefore, respectfully requested.

B. Claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 are patentable over Wessels et al. (U.S. Patent No. 5,669,120) under 35 U.S.C. § 102(b).

Consideration of the patentability of the different groups of claims subject to this rejection as identified below are respectfully requested.

Claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55

Claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 stand rejected under 35 U.S.C. §102(b) over Wessels et al. (U.S. Patent No. 5,669,120). Appellants respectfully disagree and request review and reversal of this rejection by the Board.

Appellants submit that claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 are not anticipated by Wessels et al. because Wessels et al. does not teach each and every element of the rejected claims as is required for a rejection based on anticipation. *See, e.g., Shearing v. Iolab*

Corp., 975 F.2d 1541, 1544-1545, 24 USPQ2d 1133, 1136 (Fed. Cir. 1992); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989), *cert. denied*, 493 US 853 (1989); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 894, 221 USPQ 669, 673 (Fed. Cir. 1984), *cert. denied*, 469 US 857 (1984).

Each of the independent claims subject to this rejection (i.e., claims 21, 40, and 48) recites a plurality of discrete polymeric regions fused *to* a first major side of the web. A plurality of stems extends from each discrete polymeric region of the plurality of polymeric regions. Figure 1 of Appellants' specification clearly illustrates one example of the claimed configuration.

In contrast to claims 21, 40, and 48, Wessels et al. discloses a molded surface fastener wherein a synthetic resin (that forms hook elements) *encapsulates* the substrate (see, e.g., Figure 4A-4F). In fact, Wessels et al. makes clear that the woven or knit cloth to be used "must have adequate pores for the passage of molten resin." (Col. 3, lines 36-37). Thus, when manufactured, the molten resin passes through the pores of the woven or knit cloth "to embed the foundation structure of the pile woven or knit cloth in the molten resin." (Col. 4, lines 14-20, emphasis added).

Thus, the resin that forms the hooks in Wessels et al. does so by encapsulating, i.e., flowing through, its base substrate rather that fusing to a first major side as recited by the claims. As a result, Wessels et al. cannot anticipate claims 21, 40, and 48. In support of the anticipation rejection based on Wessels et al., it is asserted that "the 'encapsulation' in Wessels et al. achieves polymeric regions fused to a first major side of the web." Office Action, p.6 (December 23, 2003) (emphasis in original). Appellants respectfully disagree.

The definition of "fused" as used by the Examiner to support a finding that polymeric regions that encapsulate a substrate are equivalent to "polymeric regions fused to a first major side" of a substrate is unduly broad. The claims should be interpreted by giving the words used in the claims "the broadest reasonable meaning of the words in their ordinary usage as they

would be understood by one of ordinary skill in the art, taking into account whatever enlightenment by way of definitions or otherwise that may be afforded by the written description contained in applicant's specification." MPEP § 2111, p. 2100-47 (8th Ed., Rev. 2, May 2004) (citing *In re Morris*, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027-28 (Fed. Cir. 1997). In addition, "[t]he broadest reasonable interpretation of the claims must also be consistent with the interpretation that those skilled in the art would reach. *Id.*

Appellants respectfully submit that the meaning of "fused to a first major side of the web" as recited in each of the independent claims subject to this rejection cannot be reasonably broadened to include encapsulation of the entire web as asserted. For example, nowhere does the specification hint that encapsulation of the entire web is contemplated as being equivalent to fusing the polymeric regions to a surface of the web. In fact, the specification explicitly recites that although polymeric regions are located on one major surface of the web, some embodiments may include polymeric regions fused to both major surfaces of the web. *See, e.g.,* Specification, p. 4, lines 26-29. In addition, the figures provided to illustrate exemplary embodiments of the invention all depict polymeric regions fused to a surface of the web, not encapsulating the entire thickness of the web.

In view of the above, Appellants submit that attempts to broaden the meaning of "fused to a major surface of the web" to include encapsulation of a web as taught by Wessels et al. is not consistent with the interpretation that would be reached by one of ordinary skill in the art. As a result, that interpretation cannot be relied on to support the anticipation rejection based on Wessels et al.

In response to Appellants' arguments, the Examiner asserted that "Figures 4A-4F do <u>not</u> show that resin, which forms hook elements, *encapsulates* the substrate. As admitted by Appellants, the resin passes through the pores of woven or knit cloth to embed the foundation structure of the woven or knit cloth." Advisory Action, p. 3 (May 18, 2004). Appellants submit

that whether the resin "encapsulates" or "embeds" the substrate, the result is the same – the substrate is completely contained within the base of the resin structure and the resin structures are not "fused to a major surface of the web" as recited in the rejected claims.

The Examiner also asserts, in the Advisory Action, that Appellants have failed to provide a negative limitation that the polymeric regions do not embed the substrate. Appellants respectfully submit that because the language "fused to a major surface of the substrate" (when properly construed in view of the specification) clearly indicates that the polymeric regions are fused to a major surface, no such limitation is necessary to distinguish the rejected claims.

Claims 22-26, 28-31, 33, 39, 42-47, 50-53, and 55, which depend from one of independent claims 21, 40, and 48, are not anticipated by Wessels et al. for the same reasons as presented above. In addition, such dependent claims each recite additional elements that further support patentability when combined with their respective independent claims.

For at least the above reasons, Appellants submit that claims 21-26, 28-31, 33, 39, 40, 42-48, 50-53, and 55 are not anticipated by Wessels et al. Review and reversal of this rejection of this rejection by the Board are, therefore, respectfully requested.

Claims 23, 42-48, 50-53 & 55:

Claims 23, 42-48, 50-53 & 55 stand rejected under 35 U.S.C. §102(b) over Wessels et al. (U.S. Patent No. 5,669,120). Appellants respectfully disagree and request review and reversal of this rejection by the Board for the reasons presented below (in addition to the reasons presented above).

All of claims 23, 42-48, 50-53 & 55, in variation or another, recite an elastic web. In the response filed on April 23, 2004, Appellants noted that Wessels et al. does not teach the use of an elastic web and, thus, cannot anticipate these claims because Wessels does not teach each and every element of the rejected claims. *See, e.g., Shearing v. Iolab Corp.*, 975 F.2d 1541, 1544-

1545, 24 USPQ2d 1133, 1136 (Fed. Cir. 1992); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989), *cert. denied*, 493 US 853 (1989); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 894, 221 USPQ 669, 673 (Fed. Cir. 1984), *cert. denied*, 469 US 857 (1984).

Appellants have challenged the Examiner to identify where or how Wessels et al. taught the use of elastic webs. The Examiner has not, however, identified where Wessels et al. teach the use of an elastic web because Wessels et al. does not do so. In fact, the Examiner has admitted that "Wessels et al. fail to teach that the web construction comprises nonwoven elastic material." Office Action, p. 7 (July 30, 2003).

Because Wessels et al. does not teach or disclose the use of elastic substrates, the anticipation rejection of claims 23, 42-48, 50-53 and 55 over Wessels et al. cannot be sustained. Review and reversal of this rejection by the Board are, therefore, respectfully requested.

C. Claims 32, 41, and 54 are patentable over Thomas (U.S. Patent No. 5,586,371) in view of Murasaki (U.S. Patent No. 5,643,651) under 35 U.S.C. § 103(a).

Claims 32, 41, and 54 stand rejected under 35 U.S.C. §102(e) over Thomas (U.S. Patent No. 5,586,371), in view of Murasaki (U.S. Patent No. 5,643,651). Appellants respectfully disagree and request review and reversal of this rejection by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants submit that claims 32, 41, and 54 are not *prima facie* obvious over Thomas in view of Murasaki because the cited references do not teach or suggest all of the claim limitations. As stated above in regard to the 35 U.S.C. § 102(b) rejection of claims 21, 40, and 48 (from which claims 32, 41, and 54 depend), Thomas does not teach every element of claims 21, 40, and 48 (e.g., a plurality of stems extending from each discrete polymeric region, polymeric regions fused to a first major side of the web, and fusing of the polymeric material to the web). In support of this rejection, the Examiner has not identified how the missing elements are suggested. Nor has the Examiner identified anything in Murasaki that remedies the deficiencies of Thomas.

Further, the Examiner has not identified how or why one of ordinary skill in the art would modify the teachings of Thomas with those of Murasaki to reach the claimed invention. The Examiner has mistakenly equated the loops of Thomas with stems (as discussed herein with respect to the anticipation rejection based on Thomas) and then combined the actual hook or stem fasteners of Murasaki to reach the claimed invention. First, Appellants disagree that the loops of Thomas are equivalent to "stems" as recited in the present invention (as discussed herein).

Second, Appellants disagree with the assertion that one of ordinary skill in the art would consider modifying the loops of Thomas to obtain "loops" oriented in different directions as asserted in the Office Action. No discussion is provided as to how one of ordinary skill in the art could accomplish this goal, or whether there would be any reasonable likelihood of success in obtaining loops oriented in different directions. As a result, Appellants respectfully submit that a proper *prima facie* case of obviousness has not been presented.

In support of this rejection, it was asserted that "[t]he Office Action does not equate the loops of Thomas with stems. Each loop or hook in Thomas has a base portion, a stem portion and upper portion." This assertion is not, however accompanied by identification of where or

how Thomas discloses that each loop includes "a base portion, a stem portion and upper portion." Thomas itself does not describe the loops as having stems. Rather, the term "stem" is used by Thomas in connection with hooks, not loops. Loops do not have stems because they are simply loops. Attempts to mix the teachings of Thomas with respect to hooks and loops are not supported by the reference itself and cannot be used to form the basis for a proper *prima facie* case of obviousness.

For at least these reasons, Appellants submit that claims 32, 41, and 54 are not *prima facie* obvious over Thomas in view of Murasaki. Review and reversal of this rejection by the Board are, therefore, respectfully requested.

D. Claim 36 is patentable over Thomas (U.S. Patent No. 5,586,371) under 35 U.S.C. § 103(a).

Claim 36 stands rejected under 35 U.S.C. §103(a) over Thomas (U.S. Patent No. 5,586,371). Appellants respectfully disagree and request review and reversal of this rejection by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants submit that claim 36 is not *prima facie* obvious as asserted because Thomas does not teach or suggest all of the claim limitations. As discussed above in regard to the 35 U.S.C. § 102(b) rejection of claim 21 (from which claim 36 depends), Thomas does not teach every element of claim 21 (e.g., a plurality of stems extending from each discrete polymeric

region, polymeric regions fused to a first major side of the web, and fusing of the polymeric material to the web). In support of this rejection, the Examiner has not identified how the elements missing from Thomas are suggested. As a result, a *prima facie* case of obviousness has not been established for claim 36 in view of Thomas.

For at least these reasons, Appellants submit that claim 36 is not *prima facie* obvious in view of Thomas. Review and reversal of this rejection by the Board are, therefore, respectfully requested.

E. Claim 38 is patentable over Thomas (U.S. Patent No. 5,586,371) in view of Shephard et al. (U.S. Patent No. 6,205,623) under 35 U.S.C. § 103(a).

Claim 38 stands rejected under 35 U.S.C. §103(a) over Thomas (U.S. Patent No. 5,586,371) in view of Shephard et al. (U.S. Patent No. 6,205,623). Appellants respectfully disagree and request review and reversal of this rejection by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants submit that claim 38 is not *prima facie* obvious over Thomas in view of Shephard et al. because the cited references do not teach or suggest all of the claim limitations. As stated above in regard to the 35 U.S.C. § 102(b) rejection of claim 21 (from which claim 38 depends), Thomas does not teach every element of claim 21 (e.g., a plurality of stems extending from each discrete polymeric region, polymeric regions fused to a first major side of the web, and fusing of the polymeric material to the web). In support of this rejection, the Examiner has not

identified how the missing elements are suggested. Nor has the Examiner identified anything in Shephard et al. that remedies the basic deficiencies of Thomas or identified how one of ordinary skill in the art would modify the teachings of Thomas with those of Shephard et al. to reach the claimed invention.

In addition, Appellants respectfully submit that even if, for the sake of argument, a mushroom fastener is equivalent to a hook for fastening purposes, a *prima facie* case of obviousness would require some reasonable expectation of success for the asserted modification. *Id.* Given that the teachings of Thomas are entirely directed at the manufacture of hooks or loops by severing strands of polymer under tension such that the severed strands recoil to form loops, Appellants submit that a proper *prima facie* case of obviousness would require that the Examiner identify or discuss how one of ordinary skill in the art would modify the teachings of Thomas to provide mushroom shaped fasteners as recited in claim 38. No such discussion has, however, been provided and, as a result, a *prima facie* case of obviousness has not been established.

Appellants note further that Shephard et al. does not teach or suggest the formation of a "mushroom head" on a loop. Such actions are limited to stems or hooks, not loops. Any assertion that Shephard et al. teaches or suggests the formation of a mushroom head on the loops of Thomas are, therefore, not supported by the cited references and cannot be relied upon as the basis for *prima facie* obviousness.

For at least the above reasons, Appellants submit that claim 38 is not *prima facie* obvious over Thomas in view of Shephard et al. Review and reversal of this rejection by the Board are, therefore, respectfully requested.

F. Claims 32, 41, and 54 are patentable under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Murasaki (U.S. Patent No. 5,643,651)

Consideration of the patentability of the different groups of claims subject to this rejection as identified below are respectfully requested.

Claims 32, 41 & 54:

Claims 32, 41, and 54 stand rejected under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Murasaki (U.S. Patent No. 5,643,651). Appellants respectfully disagree with this rejection and request review and reversal by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants submit that claims 32, 41, and 54 are not *prima facie* obvious over Wessels et al. in view of Murasaki because the cited references do not teach or suggest all of the claim limitations. As stated above in regard to the 35 U.S.C. § 102(b) rejection of claims 21, 40, and 48 (from which claims 32, 41, and 54 depend), Wessels et al. does not teach, or even suggest, each and every element of claims 21, 40, and 48 (e.g., polymeric regions fused to a first major side of the web). In support of this rejection, the Examiner has not identified how the missing elements are suggested. Nor has the Examiner identified anything in Murasaki that remedies the deficiencies of Wessels et al.

Because the Examiner has not identified why or how one of ordinary skill in the art would combine/modify the cited references to reach the inventions recited in claims 32, 41, and 54,

Appellants submit that a proper case of *prima facie* obviousness has not been established. Review and reversal of the rejection of claims 32, 41, and 54 as obvious over Wessels et al. in view of Murasaki are, therefore, respectfully requested.

Claims 41 & 54:

Claims 41 & 54 stand rejected under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Murasaki (U.S. Patent No. 5,643,651). Appellants respectfully disagree with this rejection and request review and reversal by the Board. Appellants respectfully disagree and request review and reversal of this rejection by the Board for the reasons presented below (in addition to the reasons presented above with respect to claims 32, 41, and 54 together).

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Claims 41 and 48, in one variation or another, recite an elastic web. In the response filed on April 23, 2004, Appellants noted that the cited references do not teach or suggest the use of an elastic web. The Examiner has not identified why or how one of ordinary skill in the art would combine/modify Wessels et al. and Murasaki to reach the inventions recited in claims 41 and 48 (which recite an elastic web).

Because the Examiner has not identified why or how one of ordinary skill in the art would combine/modify the cited references to reach the inventions recited in claims 41 and 54, Appellants submit that a proper case of *prima facie* obviousness has not been established.

Review and reversal of the rejection of claims 41 and 54 as obvious over Wessels et al. in view of Murasaki are, therefore, respectfully requested.

G. Claims 34-37 are patentable under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120).

Claims 34-37 stand rejected under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120). Appellants respectfully disagree with this rejection and request review and reversal by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants submit that claims 34-37 are not *prima facie* obvious over Wessels et al. because the cited reference does not teach or suggest all of the claim limitations. As stated above in regard to the 35 U.S.C. § 102(b) rejection of claim 21 (from which claims 34-37 depend), Wessels et al. does not teach, or even suggest, each and every element of claim 21 (e.g., polymeric regions fused to a first major side of the web). In support of this rejection, the Examiner has not identified how the missing elements are suggested as would be required for a proper *prima facie* obviousness rejection.

Because the Examiner has not identified why or how one of ordinary skill in the art would modify Wessels et al. to reach the inventions recited in claim 34-37, Appellants submit that a proper case of *prima facie* obviousness has not been established. Review and reversal of the rejection of claims 34-37 as obvious over Wessels et al. are, therefore, respectfully requested.

H. Claims 40, 42-48, 50-53, 55, 56, and 58-70 are patentable under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Allen et al. (U.S. Patent No. 5,547,531)

Consideration of the patentability of the different groups of claims subject to this rejection as identified below are respectfully requested.

Claims 40, 42-48, 50-53, 55, 56, and 58-70

Claims 40, 42-48, 50-53, 55, 56, and 58-70 stand rejected under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Allen et al. (U.S. Patent No. 5,547,531). Appellants respectfully disagree with this rejection and request review and reversal by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

As stated above with regard to the 35 U.S.C. § 102(b) rejection of claims 40 and 48 (from which claims 42-48, 50-53, and 55 depend), Wessels et al. does not teach each and every element of claims 40 and 48 (e.g., polymeric regions fused to a first major side of the web). In support of this rejection, the Examiner has not identified how the missing elements are suggested. Nor has the Examiner identified anything in Allen et al. that remedies the basic deficiencies of Wessels et al.

Furthermore, these same arguments apply equally to independent claim 56 and its dependent claims 58-70 even though claims 56 and 58-70 were not rejected as anticipated by

Wessels et al. because the patentable limitations recited in claim 40 are also found in independent claim 56.

Because the Examiner has not identified why or how one of ordinary skill in the art would combine/modify the cited references to reach the inventions recited in claims 40, 42-48, 50-53, 55, 56, and 58-70, Appellants submit that a proper case of *prima facie* obviousness has not been established. Review and reversal of the rejection of claims 40, 42-48, 50-53, 55, 56, and 58-70 as obvious over Wessels et al. in view of Allen et al. are, therefore, respectfully requested.

Claims 56 and 58-70:

Claims 56 and 58-70 stand rejected under 35 U.S.C. §103(a) over Wessels et al. (U.S. Patent No. 5,669,120) in view of Allen et al. (U.S. Patent No. 5,547,531). Appellants respectfully disagree with this rejection and request review and reversal by the Board.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See, e.g., In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

In addition to the reasons presented above with respect to the obviousness rejection of claims 40, 42-48, 50-53, 55, 56, and 58-70, Appellants note that independent claim 56 also recites that the polymer of the at least one discrete polymeric region is entangled with a fibrous surface of the nonwoven web. The Examiner has not identified such a teaching in either Wessels et al. or Allen et al.

If it is the Examiner's intent to rely on inherency to supply the missing feature, the Examiner has not discussed how or why such a feature would inherently be found in either

reference. The standard for inherency requires that the asserted result (i.e., entanglement) must necessarily result from the process disclosed in one of the references. "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). *See also, In re Robertson,* 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) ("Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.") Appellants respectfully submit that the burden of establishing inherency has not been met in the present rejection.

In addition, this rejection is based on the combination of Wessels et al. in view of Allen et al. in which the woven or knit web of Wessels et al. is replaced by the nonwoven fibrous web joined to an elastic backing as disclosed by Allen et al. The asserted combination does not, however, possess a reasonable expectation of success as required for a proper *prima facie* case of obviousness.

Wessels et al. describe in great detail the need for the polymeric material of the hooks to encapsulate the substrate. *See, e.g.,* Wessels et al., col. 3, line 1 to col. 4, line 67. In contrast, the elastomeric backings 34 of Allen et al. are generally described as films, with no specific need for openings that would allow encapsulation as discussed in connection with Wessels et al. As a result, Appellants respectfully submit that the asserted modification of Wessels et al. using the substrates of Allen et al. would not reasonably be expected to form a successful product.

Furthermore, given the relative timing of the two patents, it seems clear that the inventors of Wessels et al. knew of the existence of nonwoven webs and dismissed their use in connection with their invention. In fact, Wessels et al. explicitly recite that woven or knitted webs are the only ones considered for use in connection with the process, stating that "since the pile core sheet

is manufactured by weaving or knitting . . ." Wessels et al., col. 10, lines 54-56. It is clear that Wessels et al. did not contemplate that other substrates could be used in connection with their invention and the rejection based on Wessels et al. in view of Allen et al. provides no substantive reasoning as to why the proposed modifications would be attempted by one of ordinary skill in the art or successful if tried.

For at least the above reasons, Appellants submit that claims 56 and 58-70 are not *prima facie* obvious over Wessels et al. in view of Allen et al. Review and reversal of this rejection are, therefore, respectfully requested.

VIII. Summary

For the foregoing reasons, Appellants respectfully request that the Board review and reverse the rejections of claims 21-48 and 50-70 as discussed herein and that notification of the allowance of these claims be issued.

Respectfully submitted,

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APPENDIX I.

Serial No.: 09/822,651

Docket No.: 54407US006

Pending, rejected claims 21-48 and 50-70 are provided below.

1-20. (Canceled)

21. (Rejected) A web construction comprising:

a web coextensive with the web construction, wherein the web comprises two opposing sides and an indefinite length;

a plurality of discrete polymeric regions fused to a first major side of the web; and

a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions.

22. (Rejected) A web construction according to claim 21, wherein the web comprises loop structures adapted to lock with the plurality of stems.

23. (Rejected) A web construction according to claim 21, wherein the web comprises an elastic web.

24. (Rejected) A web construction according to claim 21, wherein the web comprises fibrous material.

25. (Rejected) A web construction according to claim 21, wherein the web comprises a porous web.

26. (Rejected) A web construction according to claim 21, wherein the web comprises woven web material.

27. (Rejected) A web construction according to claim 21, wherein the web comprises nonwoven web material.

28. (Rejected) A web construction according to claim 21, wherein the web comprises knit web material.

29. (Rejected) A web construction according to claim 21, wherein the plurality of discrete regions comprises a plurality of stripes extending over the first major side of the web.

30. (Rejected) A web construction according to claim 21, wherein the plurality of discrete regions comprises a plurality of patches on the first major side of the web.

31. (Rejected) A web construction according to claim 21, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane.

32. (Rejected) A web construction according to claim 21, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane, and further wherein the plurality of stems is angled in multiple directions.

33. (Rejected) A web construction according to claim 21, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane, and further wherein the plurality of stems is angled in the same direction.

34. (Rejected) A web construction according to claim 21, wherein the plurality of discrete regions covers between 1 and 99 percent of the first major side of the web.

35. (Rejected) A web construction according to claim 21, wherein the plurality of discrete regions covers between 20 and 80 percent of the first major side of the web.

36. (Rejected) A web construction according to claim 21, wherein the plurality of discrete regions covers between 5 and 25 percent of the first major side of the web.

37. (Rejected) A web construction according to claim 21, wherein the plurality of discrete regions is separated from one another by an average of approximately 0.05 and 30 centimeters.

38. (Rejected) A web construction according to claim 21, wherein each stem of the plurality of stems comprises a mushroom head.

39. (Rejected) A web construction according to claim 21, wherein each stem of the plurality of stems comprises a hook.

40. (Rejected) A web construction comprising:

an elastic web coextensive with the web construction;

a plurality of discrete polymeric regions fused to a first major side of the web; and

a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane.

41. (Rejected) A web construction according to claim 40, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane, and further wherein the plurality of stems is angled in multiple directions.

42. (Rejected) A web construction according to claim 40, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane, and further wherein the plurality of stems is angled in the same direction.

43. (Rejected) A web construction according to claim 40, wherein the plurality of discrete regions comprises a plurality of stripes extending over the first major side of the web.

44. (Rejected) A web construction according to claim 40, wherein the plurality of discrete regions comprises a plurality of patches on the first major side of the web.

45. (Rejected) A web construction according to claim 40, wherein the web comprises loop structures adapted to lock with the plurality of stems.

46. (Rejected) A web construction according to claim 40, wherein the web comprises fibrous material.

47. (Rejected) A web construction according to claim 40, wherein the web comprises a porous web.

48. (Rejected) A web construction comprising:

an elastic web comprising loop structures, wherein the elastic web is coextensive with the web construction;

a plurality of discrete polymeric regions fused to a first major side of the web; and

a plurality of stems extending from each discrete polymeric region of the plurality of polymeric regions, wherein the plurality of stems is adapted to lock with the loop structures of the web.

49. (Canceled)

50. (Rejected) A web construction according to claim 48, wherein the web comprises fibrous material.

51. (Rejected) A web construction according to claim 48, wherein the plurality of discrete regions comprises a plurality of stripes extending over the first major side of the web.

52. (Rejected) A web construction according to claim 48, wherein the plurality of discrete regions comprises a plurality of patches on the first major side of the web.

53. (Rejected) A web construction according to claim 48, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane.

54. (Rejected) A web construction according to claim 48, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane, and further wherein the plurality of stems is angled in multiple directions.

55. (Rejected) A web construction according to claim 48, wherein the web defines a localized plane, and wherein the plurality of stems is oriented at an angle that is not normal to the localized plane, and further wherein the plurality of stems is angled in the same direction.

56. (Rejected) A mechanical fastener comprising:

a nonwoven web with at least one discrete polymeric region fused to a first major side of the nonwoven web such that polymer of the at least one discrete polymeric region is entangled with a fibrous surface of the nonwoven web; and

a plurality of stems extending from the at least one discrete polymeric region.

57. (Rejected) A mechanical fastener according to claim 56, wherein the nonwoven web comprises a composite comprising a film layer.

58. (Rejected) A mechanical fastener according to claim 56, wherein the nonwoven web comprises an elastic web.

59. (Rejected) A mechanical fastener according to claim 56, wherein the at least one discrete polymeric region is surrounded by exposed portions of the nonwoven web.

60. (Rejected) A mechanical fastener according to claim 56, wherein the at least one discrete polymeric region comprises a stripe extending over the first major side of the nonwoven web.

61. (Rejected) A mechanical fastener according to claim 56, wherein the at least one discrete polymeric region comprises a plurality of discrete polymeric regions on the first major side of the nonwoven web.

62. (Rejected) A mechanical fastener according to claim 61 wherein the plurality of discrete polymeric patches are separated from one another by an average of approximately 0.05 to 30 centimeters.

63. (Rejected) A mechanical fastener according to claim 56, wherein the at least one discrete polymeric region covers between 1 and 99 percent of the first major side of the nonwoven web.

64. (Rejected) A mechanical fastener according to claim 56 wherein the at least one discrete polymer region covers between 20 and 80 percent of the first major side of the nonwoven web.

65. (Rejected) A mechanical fastener according to claim 56, wherein the at least one discrete polymer region covers between 5 and 25 percent of the first major side of the nonwoven web.

66. (Rejected) A mechanical fastener according to claim 56, wherein each stem of the plurality of stems comprises a mushroom head.

67. (Rejected) A mechanical fastener according to claim 56, wherein each stem of the plurality of stems comprises a hook.

68. (Rejected) A mechanical fastener according to claim 56, wherein the mechanical fastener comprises a diaper fastener.

69. (Rejected) A mechanical fastener according to claim 57, wherein the nonwoven web comprises elastic material.

70. (Rejected) A mechanical fastener according to claim 60, wherein the stripe extends in a transverse direction across the nonwoven web.

APPENDIX II.

Serial No.: 09/822,651

Docket No.: 54407US006

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1. Thomas (U.S. Patent No. 5,586,371)
2. Murasaki (U.S. Patent No. 5,643,651)
3. Wessels et al. (U.S. Patent No. 5,669,120)
4. Shepard et al. (U.S. Patent No. 6,205,623)
5. Allen et al. (U.S. Patent No. 5,547,531)

US005586371A

United States Patent [19]

Thomas

[11] Patent Number: 5,586,371

[45] Date of Patent: Dec. 24, 1996

[54] **METHOD FOR MANUFACTURING REFASTENABLE FASTENING SYSTEMS INCLUDING A FEMALE LOOP FASTENING COMPONENT AND THE PRODUCT PRODUCED THEREFROM**

[75] Inventor: **Dennis A. Thomas**, Cincinnati, Ohio

[73] Assignee: **The Procter & Gamble Company**, Cincinnati, Ohio

[21] Appl. No.: **336,277**

[22] Filed: **Nov. 8, 1994**

[51] **Int. Cl.**[6] **A44B 18/00**

[52] **U.S. Cl.** **24/452**; 24/306; 24/448

[58] **Field of Search** 24/306, 442, 443, 24/445–452

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,714,750	8/1955	Facciolo .	
3,417,440	12/1968	Billarant	24/450 X
3,522,637	8/1970	Brumlik	24/451 X
3,557,407	1/1971	Lemelson .	
3,745,587	7/1973	Bradley	2/114
4,654,246	3/1987	Provost et al.	428/88
4,794,028	12/1988	Fischer	428/100
4,872,243	10/1989	Fischer	24/442
4,973,326	11/1990	Wood et al.	24/450 X
4,984,339	1/1991	Provost et al.	24/452
5,032,122	7/1991	Noel et al.	24/442 X
5,058,247	10/1991	Thomas et al.	24/448
5,100,400	3/1992	Mody et al.	604/391
5,116,563	5/1992	Thomas et al.	24/442 X
5,131,119	7/1992	Murasaki et al.	24/452
5,180,534	1/1993	Thomas et al.	264/145
5,230,851	7/1993	Thomas	24/442 X
5,300,058	4/1994	Goulait et al.	24/448 X
5,318,741	6/1994	Thomas	264/519
5,324,279	6/1994	Lancaster et al.	24/306 X
5,325,569	7/1994	Goulait et al.	24/448
5,326,415	7/1994	Thomas et al.	156/244.11
5,326,612	7/1994	Goulait	24/452 X
5,392,498	2/1995	Goulait et al.	24/452

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Assistant Examiner—Robert J. Sandy
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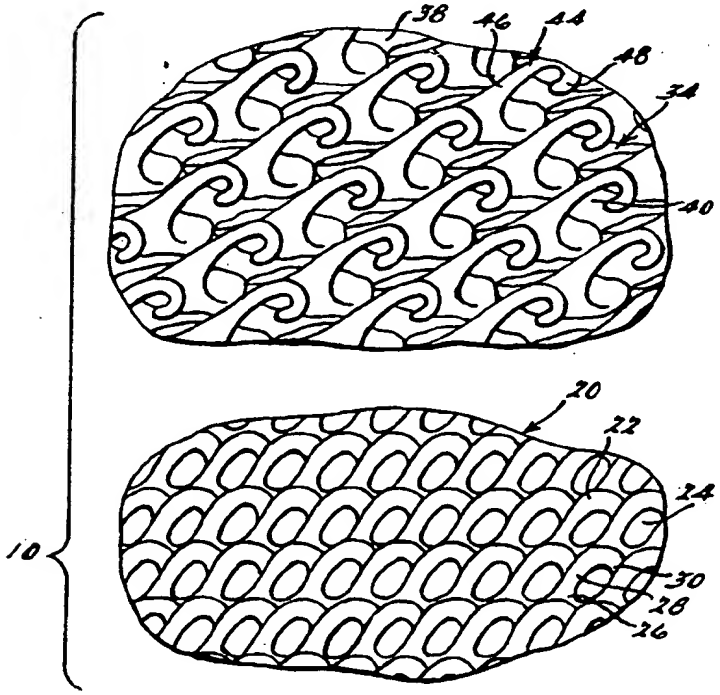
[57] **ABSTRACT**

The invention is a refastenable mechanical fastening system including rows of female loops joined to a substrate. The loops taper from the base to the distal end and are typically nonperpendicularly oriented relative to the plane of the substrate. The shanks of each loop may also have an azimuthal angle relative to the machine direction of the substrate. Each loop includes an opening for receiving a portion of the prong of a male hook component. The loops are manufactured by the process of extruding liquid material through the apertures of a depositing member onto a moving substrate to form the base of the loop, stretching the liquid material in a direction parallel to the plane of the substrate, severing the stretched material to form a distal end which fuses with an adjacent amount of stretched material to forma loop. The advantageous usage of the fastening system in an article of manufacture, such as a disposable absorbent article, and more specifically, a diaper is also disclosed.

9 Claims, 5 Drawing Sheets



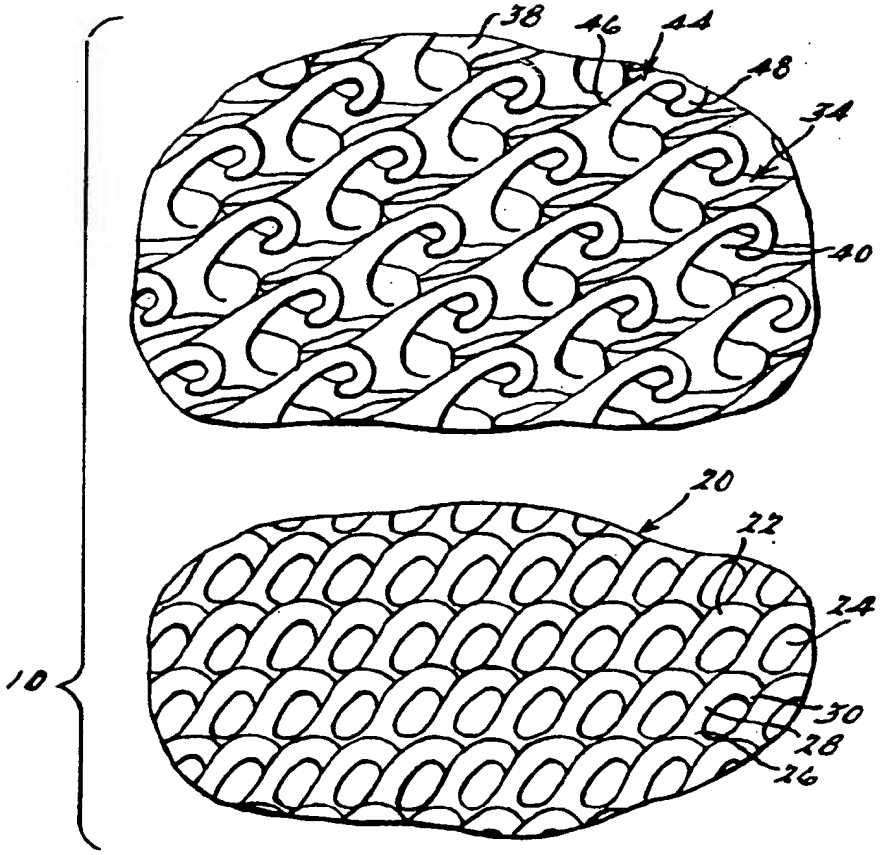


Fig. 1.

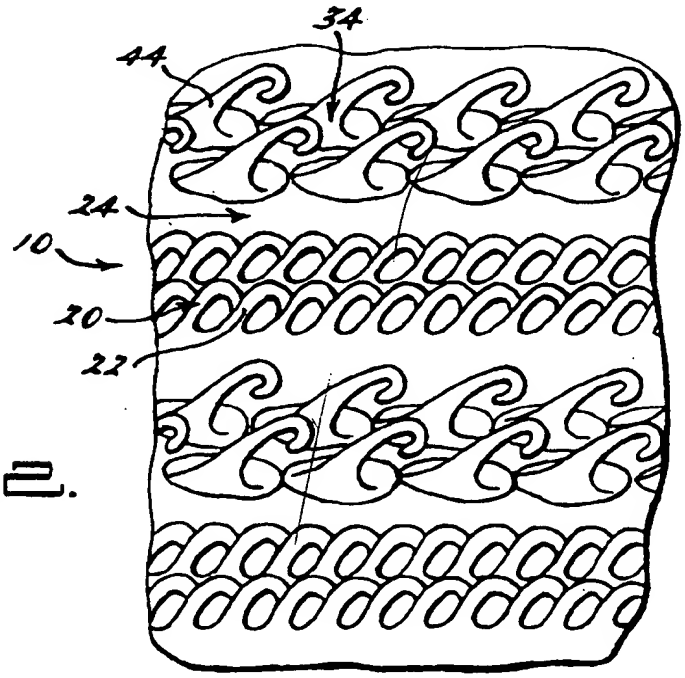


Fig. 2.

FIG. 3.

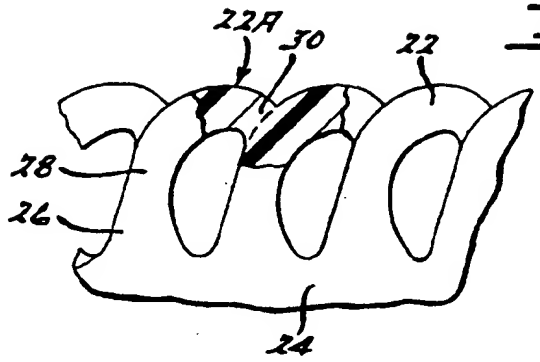


FIG. 4.

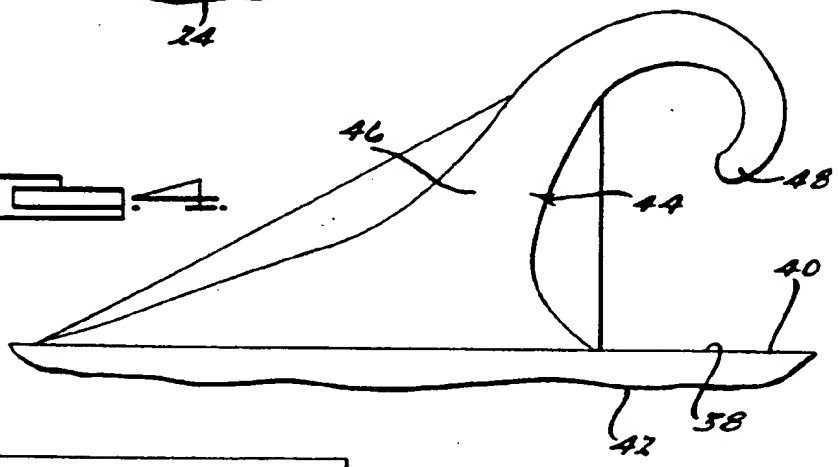
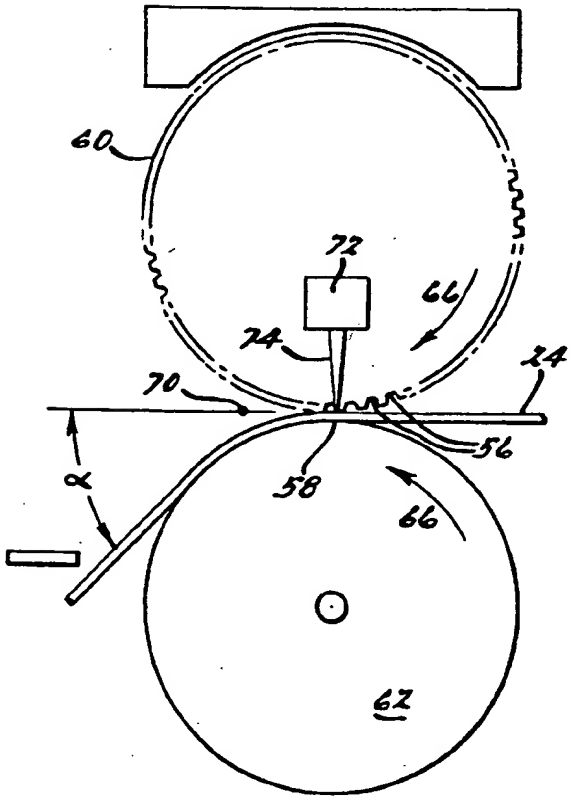


FIG. 5.



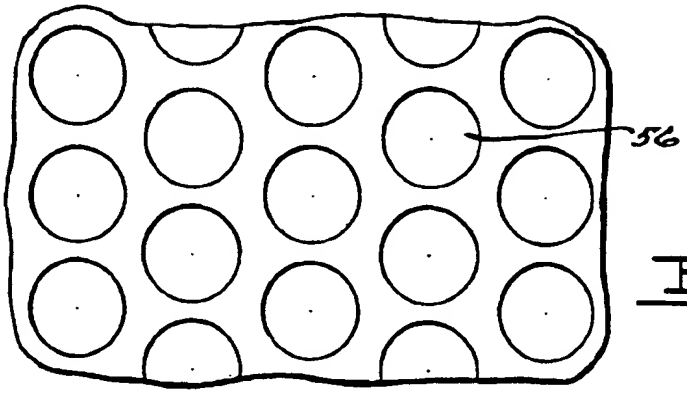


Fig. 6.

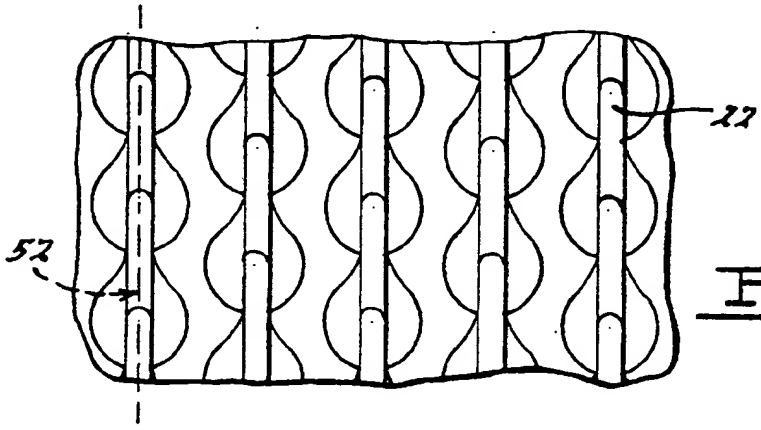


Fig. 7.

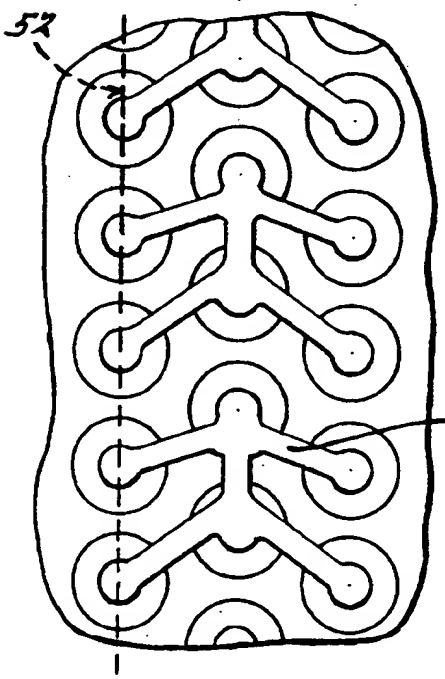


Fig. 8.

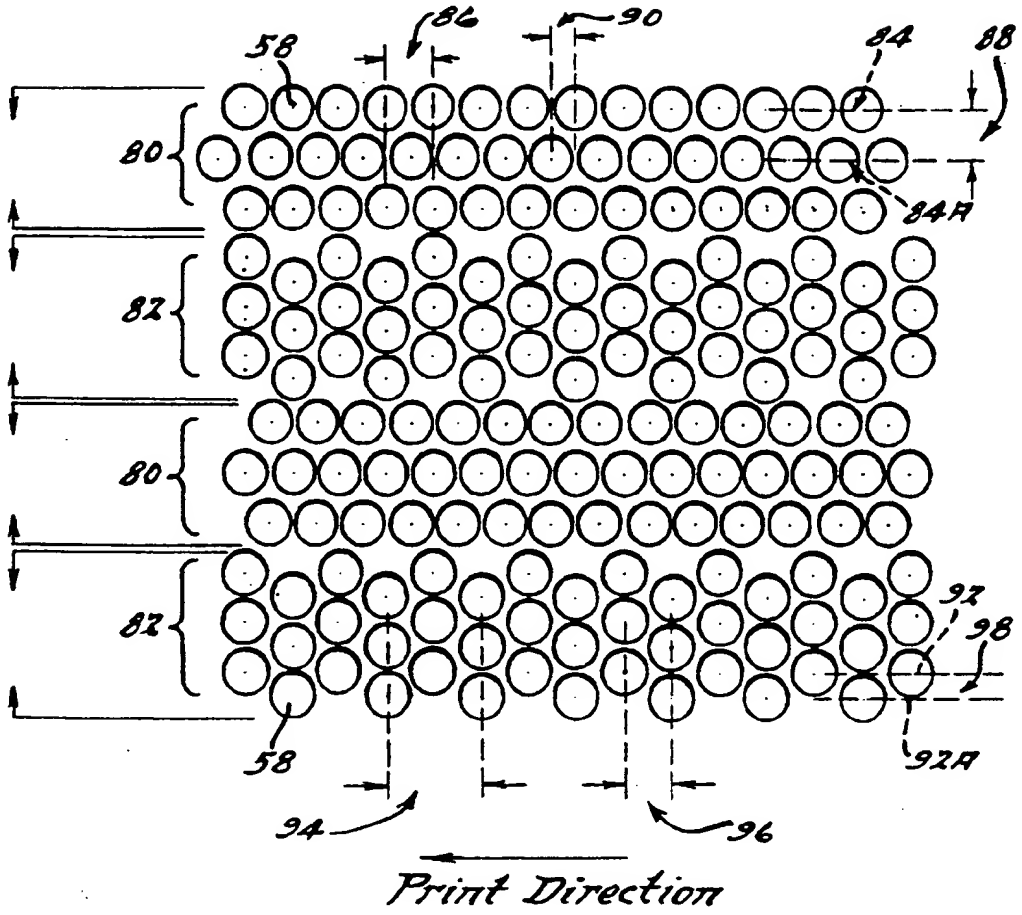

86
90
58
84
88
80
84A
82
80
82
97
98
58
92A
94
96
Print Direction

Fig. 9.

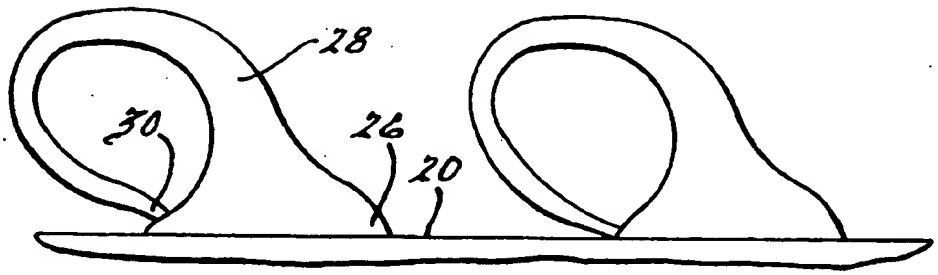

28
30
26
20

Fig. 10A.

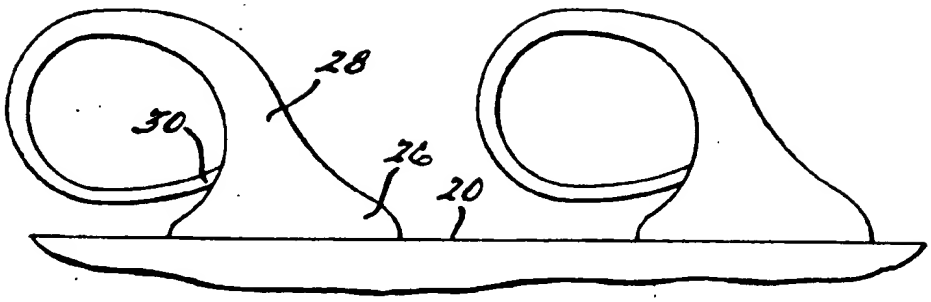

28
30
26
20

FIG. 10.

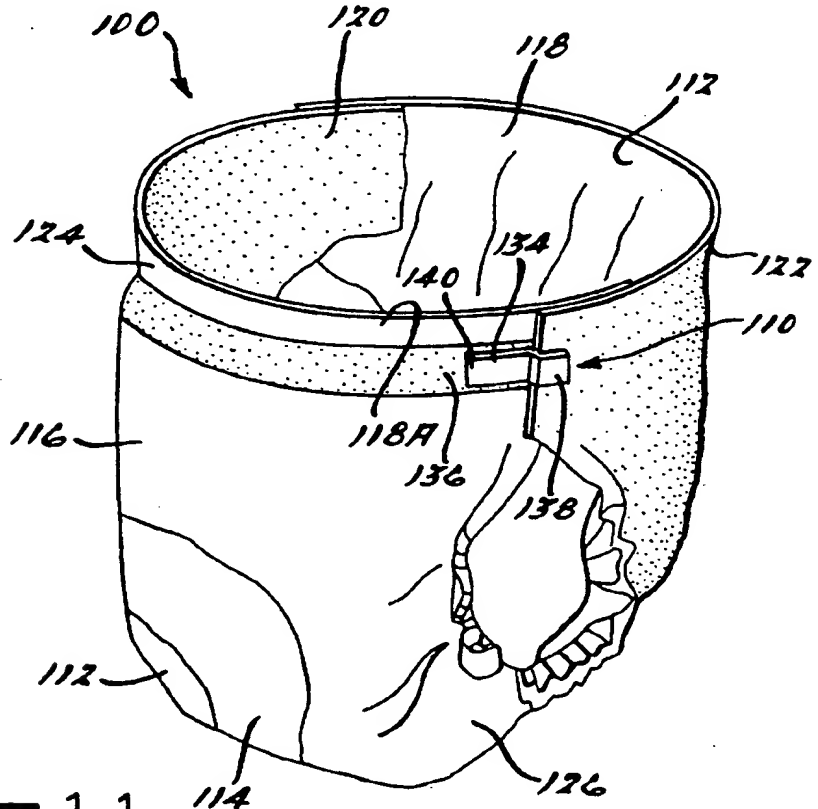

100
120
118
112
124
140
134
122
110
116
118A
136
138
112
114
126

FIG. 11.

METHOD FOR MANUFACTURING REFASTENABLE FASTENING SYSTEMS INCLUDING A FEMALE LOOP FASTENING COMPONENT AND THE PRODUCT PRODUCED THEREFROM

FIELD OF THE INVENTION

The present invention relates to refastenable fastening systems comprising a male component and a female component, and relates more particularly to the female component including free formed loops and the process of manufacturing such female components.

BACKGROUND OF THE INVENTION

Refastenable fastening devices of the hook and loop variety are currently widely used. Such refastenable fastening devices have been used in clothing, disposable articles, and various miscellaneous articles such as safety belts and the like. Such devices are used when it is desirable to create a refastenable bond between two or more articles or between several surfaces of the same article. In certain applications, these refastenable fastening devices have replaced conventional buckles, zippers, buttons, snaps, tie fasteners, and sewing.

A popular type of mechanical fastener currently in wide use which utilizes mechanical entanglement to create a refastenable bond is sold under the trademark "VELCRO". VELCRO fastening devices are described in greater detail in U.S. Pat. No. 2,717,437; U.S. Pat. No. 3,009,235; U.S. Pat. No. 3,266,113; U.S. Pat. No. 3,550,837; U.S. Pat. No. 4,169,303; and U.S. Pat. No. 4,984,339; among others.

VELCRO fasteners utilize two components, a male component and a female component. The male and female components are often referred to as the hook and loop components, respectively. The hook component consists of a fabric which contains a plurality of resilient, upstanding hook-shaped elements. The female component of the fastening device consists of a fabric containing a plurality of upstanding loops on its surface. When the hook component and the loop component are pressed together in a face-to-face relationship to close the fastening device, the hooks entangle the loops forming a plurality of mechanical bonds between the individual hooks and loops. When these bonds have been created, the components will not generally disengage under normal conditions. However, when a gradual peeling force is applied to the components, disengagement can be easily effected. Under a peeling force, since the hooks are comprised of a resilient material, they will readily open to release the loops.

While the VELCRO type of fastening devices have been found to be relatively useful on disposable diapers, disposable packages, cartons and the like, the use of such fastening devices on disposable articles has been limited due to the fact that such fastening devices are relatively costly to manufacture. The high manufacturing costs are typically associated with both the hook and the loop components of these devices.

Conventional hook and loop components of the VELCRO variety are typically formed by making a fabric with a number of woven loops extending outwardly from a backing. The loops may be provided by weaving a base fabric containing supplementary threads to form the loops, or by knitting loops into a fabric. In other hook and loop components, the loops may be formed by pleating or corrugating

processes, where the loops are subsequently cut to form the hook components.

These processes generally produce costly hook and loop fastening materials because they are relatively slow. The hook and loop components of such fastening devices are also usually made out of the same relatively expensive material. This material is generally relatively expensive for the hook component because the material used in the hook component needs to be resilient so that the hooks can disengage from the loop component when the device is opened. Additionally, the material is generally relatively expensive due to the need of such material to be strong enough to hold the engaged hooks when subjected to forces applied on the fastening device.

Several attempts have been made to make alternative types of female components for fastening devices. However, such attempts have generally suffered from a number of drawbacks.

One such attempt is described in Ribich, et al. U.S. Pat. No. 3,708,833 issued on Jan. 9, 1973. The Ribich, et al. patent discloses a refastenable fastening device having a female component that comprises reticulated urethane foam secured to a backing layer. The female component disclosed in the Ribich, et al. patent suffers from the drawback that foams typically do not have enough openings for the hooks of conventional hook components to penetrate. Reticulated foam also does not have sufficient strength to hold such hooks when forces are applied to the fastening device. Further, manufacturing reticulated foam is a relatively expensive process.

Brumlik U.S. Pat. No. 3,905,071 issued on Sep. 16, 1975 discloses a "press-through self-gripping device." The device described in the Brumlik patent does not appear to be suitable for use in a refastenable fastening device that utilizes a conventional mating hook component with resilient hooks. The fastening device disclosed in the Brumlik patent is intended to be used for fastening one or more sheets of material between a gripping member and a receiving member. The gripping member disclosed in the Brumlik patent has rigid and stiff needle-shaped elements for gripping elements. These needle-like elements are particularly unsuitable for use in fastening devices on disposable absorbent articles. The disclosure of the Brumlik patent, thus, appears to be limited to the devices that employ gripping elements adapted to penetrate and pass through several sheets of material and lodge inside a receiving member.

Therefore, there is a need for a low-cost fastening device for disposable articles. In particular, there is a need for such low-cost fastening devices to perform in a manner comparable to the more expensive commercially-available fastening devices.

It is an object of the present invention to provide an improved low-cost female component for a fastening devices.

It is another object of the present invention to provide a female component for a fastening device that can be used with both commercially-available hook components having resilient individual hooks, as well as less expensive hook components with more brittle hooks than those currently in use.

It is further object of the present invention to provide a low-cost female component that makes more efficient use of materials than existing fastening devices and that utilizes reduced amounts of expensive materials.

It is still another object of the present invention to form a low-cost female component for a refastenable fastening

device by stacking materials on top of one another which have certain desired individual characteristics for entangling and engaging the hooks of a mating hook component.

It is a still further object of the present invention to provide a low-cost and improved method for producing such a female component.

These and other objects of the present invention will be more readily apparent when considered in reference to the following description and when taken in connection with the accompanying drawings.

SUMMARY OF THE INVENTION

The invention comprises a fastening system for attachment to a complimentary receiving surface. The fastening system includes a female component having a substrate and a plurality of loops formed by fusing a number of members comprising a base, shank and distal end portion. The base of the prong is joined to the substrate and the shank is contiguous with and projects outwardly from the base. The distal end portion is joined to the shank and projects substantially laterally beyond the periphery of the shank. The shank is generally nonperpendicularly oriented relative to the plane of the substrate. The shank has a leading edge and a trailing edge defining a leading angle and trailing angle which are substantially different from each other, so that the sides of the shank are nonparallel. Optionally, the fastening system may include a male component including a plurality of hooks and a female component including a plurality of loops extending from a single substrate, wherein the hooks are essentially nonfused members sometimes referred to in the industry as prongs.

The fastening system may be made according to the process comprising the steps of heating a thermally sensitive material sufficiently to reduce its viscosity for processing, and preferably to at least its melting point, and applying the material in discrete amounts to a substrate through apertures disposed in a predetermined configuration depending upon the desired loop arrangement. The substrate to which the material is to be joined is transported in a first direction relative to the means for depositing the material and the material is deposited on the transported substrate. Once deposited, the material is stretched in a direction having a component generally parallel to the plane of the substrate and the stretched material is severed to form a distal end. The means for depositing the material and corresponding means including the apertures through which the thermally sensitive material is disposed are run at a relatively high rate of speed to cause the distal ends of the prongs to land on an adjacent member or upon itself as desired resulting in the intended loop configuration as will be described in greater detail below.

An illustrative and suitable use for the fastening systems produced by the process of the present invention is in conjunction with a disposable absorbent article, such as a diaper. This nonlimiting example of usage of the present invention is also more fully described below.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as forming the present invention, it is believed that the invention will be better understood from the following description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a perspective view of the fastening system of the present invention including a female component containing a plurality of loops and a male component containing a plurality of male hooks;

FIG. **2** is a perspective view of the fastening system of the present invention including the male component and female component disposed on the same substrate;

FIG. **3** is a side elevation view of an array of female loops of the present invention;

FIG. **4** is a side elevation view of a male prong of the present invention;

FIG. **5** is a side elevation view of one apparatus which can be used to produce the fastening systems of the present invention;

FIG. **6** is a view demonstrating the alternating orientation of the apertures for forming loops contained on the print cylinder apparatus of FIG. **5**;

FIG. **7** is a top view illustrating the orientation of offset rows of female loops formed in line;

FIG. **8** is a top view illustrating a row of agglomerated loops;

FIG. **9** is a view demonstrating the alternating orientation of apertures for forming both hooks and loops on a single substrate contained on the print cylinder apparatus of FIG. **5**;

FIG. **10** is a side elevation view illustrating a row of self included loops;

FIG. **10A** is a side elevation view illustrating a row of self included loops; and

FIG. **11** is a view of a disposable absorbent article utilizing a fastening system of the present invention, showing the topsheet and core partially cutaway.

DETAILED DESCRIPTION OF THE INVENTION

1. Overall Characteristics of the Refastenable Fastening System

A preferred embodiment of the refastenable fastening system of the present invention is shown in FIG. **1**. The fastening system **10** comprises a female component **20** and complimentary male component **34**.

The male portion of the device, hook fastening components (or simply "hook components") **34** otherwise known in the industry as a prong comprise a base **36**, such as a fabric **38** that has a first surface **40** and a second surface **42** (as shown in FIG. **4**). The fabric **36** contains a plurality of outstanding engaging elements or "hooks" **44** extending from the first surface **40**. The hooks **44** have heads **48** disposed on the top of the shanks or stems **46** that extend from the first surface. Particularly preferred hook fastening materials and methods of making such hook fastening materials are disclosed in U.S. Pat. Nos. 5,326,415 which issued Jul. 5, 1994, to Dennis A. Thomas, et al.; 5,318,741 which issued Jun. 7, 1994, to Dennis A. Thomas; 5,230,851 which issued Jul. 27, 1993, to Dennis A. Thomas; 5,058,247 which issued Oct. 22, 1991, to Dennis A. Thomas; and 5,116,567 which issued May 26, 1992, to Dennis A. Thomas, all of which have been commonly assigned to The Proctor & Gamble Company of Cincinnati, Ohio, and which patents are incorporated herein by reference.

The female portion **20** of the fastening system **10** includes a plurality of free formed loop components (or simply "look components" or "female components") **22** which receive

and are engaged by the hooks 44 of the hook component 32. The female component 22 shown in FIG. 1 comprises an array of free formed loops 22, joined to a substrate 24 in a predetermined pattern.

As illustrated with particular reference to FIG. 3, the loops 22 have a base 26, shank 28 and distal end 30 which blends into another base or shank. The bases 26 of the loops 22A contact and adhere to the substrate 24, and support the proximal ends of the shanks 28. The shanks 28 project outwardly from the substrate 24 and bases 26 in an arcuate manner. The shanks 28 terminate at a distal end 30. The arcuate projection of the shank 28 allows the distal end 30 to contact and be joined to one or more adjacent loops 22 or to fuse with itself to thereby form an opening or openings 32 for receiving the heads 48 of the hooks 44 as will be described in greater detail below.

The array of loops 22 is produced by methods which yield free formed members 22A as described and claimed hereinbelow. As used herein, the term "free formed" means a structure which is formed from a material deposited onto a substrate and which is not removed from a mold cavity or extrusion die in solid form or with a defined shape. The free formed members 22A are deposited onto a substrate 24 which will be discussed in detail hereinbelow, in a molten, preferably liquid state and solidify, become fused with another adjacent free formed member 22A or back upon itself, and upon cooling, becomes rigid to have the desired structure and shape as described hereinafter.

The free formed array of loops 22 is preferably produced by a manufacturing process which is similar to a process commonly known as rotary screen printing. This process uses a depositing member in the form of a generally cylindrical screen, referred to herein as the print cylinder 60. Using this process, a substrate 24 having opposed surfaces is passed between the nip 58 of the print cylinder 60 and a backing roll 62, as illustrated at FIG. 5. The print cylinder 60 and backing roll 62 have generally parallel centerlines and are maintained in contacting relationship with the substrate 24 as it passes through the nip 58. The depositing member, presently referred to as the print cylinder 60, has an array of perforations, as shown more clearly in FIG. 6, referred to as apertures 56. While the array of perforations or apertures 56 may have differing orientations, it has been found that arranging them in linear offset rows as shown in FIG. 6 results in a maximum number of closed loops 22 being formed per unit area.

The second roll, referred to as the backing roll 62, provides the reaction against the print cylinder 60 to position the substrate 24 against the print cylinder 60 as the substrate 24 passes through the nip 58. Liquid, thermally sensitive material, preferably thermoplastic material, from which the loops 22 are eventually formed is supplied from a heated source, such as a heated pressure bar 72. The thermally sensitive material is forced into the apertures 56 by a doctor blade 74 as the print cylinder 60 is rotated about its centerline. The thermally sensitive material is then extruded from the apertures 56 onto the substrate 24 in the desired pattern.

As relative displacement between the substrate 24 and print cylinder 60 increases, the material forming the members 22A, which eventually form the loops 22, is stretched in a direction having a lateral vector component, generally parallel to the plane of the substrate 24, forming the shank 28 and the distal ends 30. Finally, the moil of the material which forms the loop is severed from the distal end 30 by severing means 70. Due to the viscoelastic properties of the thermoplastic, the material retracts and the engaging means 30 contacts the adjacent loop material as shown in FIG. 3 to form the array of loops 22. It is also believed that the loop material retracts under the influences of gravity and shrinkage which occur during cooling. Once the material in the form of member 22A fuses with an adjacent member 22A or back upon itself, the material then cools, and preferably freezes, into a solid loop structure 22 having an orifice or opening 32 capable of receiving a male, hook component. The openings 32 allow for entry of the hooks 44 of the hook component into the plane of the female component 20, while the shanks 28 of the loops 22 prevent withdrawal or release of the hooks 44 until desired by the user, or either the peel or shear strength of the female component 20 is otherwise exceeded.

Referring to FIG. 3 to examine the make up of the female component 20 in more detail, the substrate 24 of the fastening system 20 should be strong enough to preclude tearing and separation between individual loops 22 of the female component 20, be a surface to which the loops 22 will readily adhere and be capable of being joined to an article to be secured as desired by a user. As used herein the term "join" refers to the condition where a first member, or component, is affixed, or connected to a second member or component, either directly, or indirectly, where the first member or component is affixed or connected to an intermediate member, or component which in turn is affixed, or connected, to the second member or component. The association between the first member, or component, and the second member, or component, is preferably intended to remain for the life of the article. The "substrate" is any exposed surface to which one or more loops 22 are joined.

The substrate 24 should also be capable of being rolled, to support conventional manufacturing processes, and flexible so that the substrate 24 may be bent or flexed in a desired configuration. However, more rigid structures such as cardboard or the like may also be used. The substrate 24 should also be able to withstand the heat of the liquid material which forms the loops 22 being deposited thereon without melting or incurring deleterious effects until such loops 22 freeze. However, the backing roll 62 may be chilled, allowing the process to accommodate substrates 24 which otherwise would not be able to withstand the heat of the liquid loops 22. The substrate 24 should also be available in a variety of widths. Suitable substrates 24 include knitted fabric, woven materials, nonwoven materials, rubber, vinyl and films, including polyolefinic films particularly and preferably polyester films. A polyester film substrate 24 having a basis weight of 17.1 grams per square meter (14.26 grams per square yard) and a thickness of about 0.008 to about 0.15 millimeters (0.0003 to 0.006 inches) has been found suitable. Such materials are commercially available from Hoechst Celanese of Greer, S.C. 29651 and sold under the trade name Hostaphan 2400 polyester film.

The base 26 is the generally planar portion of the loop 22 which is attached to the substrate 24 and is contiguous with the proximal end of the shank 28 of the loop. As used herein, the term "base" refers to that portion of the loop 22 which is initially in direct contact with the substrate 24 and supports the shank 28 of the loop 22. It is not necessary that a demarcation be apparent between the base 26 and the shank 28. It is preferred that the shank 28 not separate from the base 26 and that the base 26 not separate from the substrate 24 during use.

The shape of the footprint of the base 26 on the substrate 24 generally corresponds to the shape of the aperture's sectional area at the surface of the print cylinder 60. As used herein, the term "footprint" refers to the planar contact area

of the base **26** on the substrate **24**. As the aspect ratio of the sides of the footprint increases, the loop **22** may become unstable when subjected to forces, such as gravitational forces, parallel to the shorter dimension of the footprint.

For the embodiments described herein, a base **26** having a footprint of generally circular shape and approximately 0.10 millimeters to 0.30 millimeters (0.004 to 0.012 inches) in diameter is suitable. If it is desired to make the female component **20** have a greater peel or shear strength in a particular direction, the cross sectional area of the base **26** may be modified to amplify such direction, so that the strength and structural integrity relative to the axis parallel to such direction increases. This modification causes the loop **22** to be stronger when pulled in the amplified direction of the base **26**.

The shank **28** is contiguous with the base **26** and projects outwardly from the base **26** and substrate **24**. As used herein, the term "shank" refers to that portion of the loop **22** which is intermediate of and contiguous with the base **26** and the distal end **30**. The distal end **30** is joined to the shank **28** along one end and affixed to an adjacent loop **22** as shown in FIGS. **7**, **8** and **9** or to the shank of the same loop **22** along a second end as shown in FIG. **10**.

The array of loops **22** may be of various patterns and densities as desired, to achieve the peel and shear strengths required for the particular application of the fastening system **10**. The individual loops **22** should not be so closely spaced as to interfere with and prevent the hooks **44** of the male component **34** from intercepting the shanks **28** of the female component **20**. Conversely, the loops **22** should not be so distantly spaced as to require an excessive area of substrate **24** to provide a fastening system of adequate shear and peel strengths.

It is advantageous to dispose the loops **22** in rows, **52** so that each loop **22** is generally equally spaced from an adjacent loop **22**. The rows **52** are generally oriented in the machine direction and cross-machine direction according to the manufacturing process described. Generally, each machine direction and cross-machine direction row of loops **22** should be substantially equidistantly spaced from the adjacent machine direction and cross-machine direction rows of loops **22**, to provide a generally uniform stress field throughout the female component **20** and the male component **34** when separation forces are applied to the female component **20** and the male component **34**.

As used herein the term "pitch" refers to the distance, measured either in the machine direction or cross-machine direction, between the centers of the footprints of the bases **26** of loops **22** in adjacent rows. Typically a female component **20** having an array of loops **22** with a pitch ranging from about 1.0 millimeters to about 20 millimeters (0.039 to 0.078 inches) in both directions is suitable, with a pitch of about 0.64 millimeters (0.025 inches) being preferred. Adjacent machine direction rows are preferably offset approximately one-half pitch in the machine direction to double the distance in the cross direction between the adjacent machine direction rows. This concept is illustrated in FIG. **6**.

The loops **22** may be thought of as disposed in a matrix on a one square centimeter grid having an array of loops **22** with about 2 to about 20 rows of loops **22** per centimeter (5 to 50 rows per inch) in both the machine and cross-machine directions. However, when a fastening system **10** having loops **22** is used as the fastening means for a disposable diaper or incontinence brief as described more fully below or is used on a sanitary napkin as a means for securing the sanitary napkin to the panty of the wearer, it is desirable to have a fastening system that is "skin friendly." As used herein the term "skin friendly" refers to a fastening system which is substantially non-irritating and non-abrasive to human skin. It has been found that a fastening system having an array of loops **22** with about 8 to about 40 rows of loops per centimeter (20 to 100 rows per inch) in each direction will produce a fastening system **10** which is substantially non-irritating and non-abrasive to human-skin. This grid will result in a fastening system having about 64 to about 1600 prongs per square centimeter (400 to 10,000 prongs per square inch) of substrate **24**.

The method of the present invention can produce a female component having a denser array of loops than can be produced by the methods of the prior art. This is because the density of the array of loops of the present invention is essentially limited only by the number of meshes or apertures that can be produced in the depositing member. Currently, it is possible to produce a depositing member having up to about 1600 meshes per square centimeter (10,000 meshes per square inch). Therefore, it is believed that a female component having up to about 1600 loops per square centimeter (10,000 loops per square inch) can be produced using the method of the present invention.

Preferably, the fastening system **10** will have from about 64 to 1600 loops per square centimeter (400 to 10,000 loops per square inch) of substrate **24**. More preferably, the female component **20** will have from about 10 to about 30 rows of loops per centimeter (25 to 75 rows per inch). This grid will result in a female component having from about 100 to about 900 loops per square centimeter (625 to 5625 loops per square inch) of substrate. Most preferably, the female component **20** will have from about 12 to about 24 rows of loops per centimeter (30 to 60 rows per inch). This grid will result in a female component having from about 144 to about 576 loops per square centimeter (900 to 3600 loops per square inch) of substrate. In a preferred embodiment, the female component will have about 16 rows of loops per centimeter (40 rows per inch) in each direction. This grid will result in a female component having about 256 loops per square centimeter.

The loops **22** may be made of any thermally sensitive material which is stable and shape retaining when solid, but not so brittle that failure occurs when the female component **20** is subjected to separation forces. As used herein, "thermally sensitive" means a material which gradually changes from the solid state to the liquid state upon the application of heat. Failure is considered to have occurred when the loops **22** has fractured or can no longer sustain a reaction in the presence of and when subjected to separation forces. Preferably the material has elastic tensile modules, measured according to ASTM Standard D-638, of about 24,600,000 to about 31,600,000 kilograms per square meter (35,000 to 45,000 pounds per square inch).

Further, the loop material should have a melting point low enough to provide for easy processing and a relatively high viscosity to provide a tacky and tough consistency at temperatures near the material melting point, so that the shanks **28** may be stretched and the loops **22** may be easily formed according to the method of manufacture recited below. It is also important that the loops **22** be viscoelastic, to allow for more variation in the parameters affecting loop structure. Material having a complex viscosity ranging from about 20 to about 100 Pascal seconds at the temperature of application to the substrate **24** is suitable.

The viscosity may be measured with a Rheometrics Model 800 Mechanical Spectrometer using the dynamic

operating mode at 10 Hertz sampling frequency and 10% material strain. A disk and plate type geometry is preferred, particularly with a disk having a radius of about 12.5 millimeters and a gap of about 1.0 millimeter between the disk and plate.

The loops **22** are preferentially comprised of a thermoplastic material. The term "thermoplastic" refers to uncrosslinked polymers of a thermally sensitive material which flows under the application of heat or pressure. Hot melt adhesive thermoplastics are particularly well suited to manufacture the female component **20** of the present invention, particularly in accordance with the process described and claimed below. As used herein the phrase "hot melt adhesive" refers to thermoplastic compounds, normally solid at room temperature, which become fluid at elevated temperatures and which are applied in the molten state. Examples of hot melt adhesives may be found in the "Handbook Of Adhesives", Second Edition by Irving Skeist, published in 1977 by Van Nostrand Reinhold Company, 135 West 50th Street, New York, N.Y. 10020, which is incorporated herein by reference. Polyester and polyamide hot melt adhesives are particularly suitable and preferred. As used herein, the terms "polyester" and "polyamide" mean chains having repeating ester and amide units respectively.

If a polyester hot melt adhesive is selected, an adhesive having a complex viscosity of about 23±2 Pascal seconds at about 194° C. has been found to work well. If a polyamide hot melt adhesive is selected, an adhesive having a complex viscosity of about 90±10 Pascal seconds at about 204° C. has been found to work well. A polyester hot melt adhesive marketed by the Bostik Company of Middleton, Mass. as No. 7199 has been found to work well.

PROCESS OF MANUFACTURE

FIG. **5** is a side elevational, schematic view of a particularly preferred apparatus used to produce loops according to the method of the present invention. FIG. **5** shows a backing roll **62** and print cylinder **60** which form a nip **58** through which the substrate **24** passes. As the print cylinder **60** and backing roll **62** rotate about their axes, the molten loop material which is extruded through the apertures **56** of the print cylinder **60** onto the moving substrate **24**, is stretched in a direction having a vector component parallel to the plane of the substrate **24** and is severed by the means for severing **70** to produce loops having a distal end **30** joined to the shank of an adjacent loop or to itself as will be described in greater detail below. As used herein the term "extrude" refers to forcing a substance through an aperture causing the substance to be shaped at least partially, by the aperture.

The print cylinder **60** is an example of a particularly preferred depositing member which may be used with the method of the present invention. The depositing member should be made of metal or any other suitable material which can accommodate the temperatures of the molten loop material, provide substantially uniform pitch between the loops **22** in both the machine direction and cross-machine direction, and yield the desired density of loops **22** within the array.

As used herein the phrase "depositing member" refers to anything through which liquid loop material is extruded in dosages corresponding to individual loops **22**. The depositing member will generally be a smooth and relatively thin piece of metal or other material having perforations or apertures **56** through which the molten loop material is extruded onto the substrate. The depositing member may be a flat bed screen, a belt screen (such as a continuous band, belt, or conveyor having apertures) or a rotary screen, such as the screens used in the screen printing art. The depositing member, however, may also be in the form of a porous or sintered roll having an internal reservoir continuously pressure fed with molten loop material which is then extruded through the pores of the roll onto the moving substrate. As used herein the term "deposit" means to transfer loop material from the bulk form and dose such material onto the substrate **24** in units corresponding to the members **22A** which form the loop **22**.

Preferably, the depositing member will be a rotary screen or print cylinder **60**. A particularly preferred print cylinder **60** will be a metal cylinder, preferably constructed of nickel, having apertures **56** produced by any means well known in the art and preferably produced by means of photoengraving. Preferably, a circular frame will be mounted on each end of the cylinder, which will provide the screen with structural support, maintain the screen's cylindrical shape, and will also provide a means of holding the screen in position and rotating the screen about its axis without interfering with the blade assembly **74**. For convenience of description, the depositing member of the present invention shall be described as a print cylinder **60**. It is to be understood, however, that the present invention applies to any method of extruding molten loop material onto a substrate to produce a female component having free-formed loops.

The print cylinder **60** and backing roll **62** may be driven by any means well known in the art such as an external motive force (not shown), or the backing roll **62** may be driven by an external motive force and the print cylinder **60** driven by frictional engagement with the backing roll **62**, or vice-versa. Rotary screen printing apparatus which can be modified for use with the method of the present invention are commercially available from Graco/LTI Corporation, P.O. Box 1828, Monteray, Calif. 93940, such as the Graco/LTI Micro-Print hot melt adhesive applicator.

The size, shape and pattern of the apertures **56** in the print cylinder **60** may vary according to the size and shape of the loops and the density of loops **22** in the array that is required for the particular female component desired. The cross sectional area of the aperture **56**, taken at the outer surface of the print cylinder **60**, generally corresponds with the shape of the footprint of the base **26** of the loop **22**. The cross section of the aperture **56** should be approximately equal to the desired cross section of the base **26**.

To produce the loop embodiments described herein, a generally cylindrically shaped aperture **56** is adequate. If desired, however, the aperture **56** may be somewhat frustoconically tapered in shape, having a larger cross section either at the outer surface of the cylinder **60** or inner surface of the cylinder **60**. For the print cylinder embodiment described herein an aperture **56** having a diameter of about 0.15 millimeters to about 2.0 millimeters (0.006 to 0.079 inches) produces a suitable loop **22**.

There are different methods and apparatus that are suitable to supply molten loop material to the print cylinder **60** and which are well known in the art. One suitable apparatus is disclosed is Classen U.S. Pat. No. 4,876,982, issued Oct. 31, 1989, which is incorporated herein by reference. Another particularly preferred apparatus is the heated pressure bar **72** shown in FIG. **5**. The heated pressure bar **72** is disposed within the print cylinder **60** and is substantially parallel to the print cylinder **60**. The heated pressure bar **72** has an internal reservoir (not shown) which is fed with liquid loop

material and one or more discharge ports (not shown) from which the liquid loop material uniformly flows to the inside surface **76** of the print cylinder **60**. Attached to the heated pressure bar **72** is a doctor blade assembly **74**. As the print cylinder **60** rotates the doctor blade assembly **74** squeegees the molten loop material along the inner surface **76** of the printed cylinder **60** and forces the liquid loop material into the apertures **56**. The doctor blade assembly **74** not only serves to force the molten loop material through the apertures **56**, but also provides support to the print cylinder **60** at the point of the nip **58** to prevent the print cylinder **60** from buckling or deforming as it is pressed against the backing roll **62**. The backing roll **62** may be constructed of metal or any other suitable material. A backing roll **62** having a rubber coating with a Shore A durometer hardness of about 40 to about 60 may also be used. Preferably, the doctor blade assembly **74** is pressed against the print cylinder **60** with a force of about 80 pounds per square inch as the substrate **24** passes through the nip **58**. A suitable heated pressure bar **72** and doctor blade assembly **74** are commercially available from Graco/LTI Corporation, P.O. Box 1828, Monteray, Calif. 93940.

The internal reservoir of the heated pressure bar **72** should have a steady supply of thermally sensitive material. This may be provided by any means well known in the screen printing or hot melt adhesives art, but a particularly preferred method of supplying the heated pressure bar comprises a heated hose assembly (not shown), a heated tank (not shown), and a gear pump (not shown). The gear pump may be driven by a variable speed DC motor (not shown) and should provide constant uniform output at the discharge port of the heated pressure bar **72** at all line speeds. The heated tank, heated hose assembly, and heated pressure bar **72** should keep the molten loop material at the desired operating temperature. Typically, a temperature slightly above the melting point of the material is desired. The material is considered to be at or above the "melting point" if the material is partially or wholly in the liquid state. If the loop material is kept at too high a temperature, the loop material may not be viscous enough to form the member **22A** which subsequently forms the loop **22** may flow into a small, somewhat semispherically shaped puddle and a loop will not be formed. Conversely, if the temperature of the loop material is too low, the loop material may not transfer from the pressure bar **72** to the doctor blade assembly **74** or print cylinder **60** or, subsequently, may not properly transfer from the print cylinder **60** to the substrate **24** in the desired array or pattern, or the distal end **30** may not fuse with an adjacent loop **22** or back upon itself.

The print cylinder **60** is preferably heated to prevent solidification of the loops **22** during transfer from the heated pressure bar **72** through the deposition on the substrate **24**. Generally a print cylinder **60** surface temperature near the source material temperature is desired. A print cylinder **60** temperature of about 178° C. has been found to work well with the polyester hot melt adhesive marketed by the Bostik Company of Middleton, Mass. as No. 7199. But, the operating temperature of the print cylinder **60** may vary according to the particular loop material being used. There are many methods which can be used to heat the print cylinder **60**, which will be readily apparent to one skilled in the art. A particularly preferred method of heating the print cylinder **60** is by using an infrared heater (not shown).

It is to be recognized that a chill roll may be necessary if the substrate **24** is adversely affected by the heat transferred from the loop material. If a chill roll is desired, it may be incorporated into the backing roll **62** using means well known in the art. This arrangement is often necessary if a polypropylene, polyethylene or other polyolefinic substrate **24** is used.

After being deposited onto the substrate **24**, the material is severed from the depositing member by a severing means. The material is severed to form the member **22A** including the shank **28** and distal end **30** of the female component **20**, and a moil. As used herein the term "moil" refers to any material severed from the loop **22** which does not form part of the female component.

The severing means **70** should be adjustable to accommodate various sizes of loops **22** and also provide uniformity throughout the cross-machine direction of the array as will be described in greater detail below. The term "severing means" refers to anything which longitudinally separates the moil from the female component **20**. The term "sever" refers to the act of dividing the moil from the member **22A** as described above. The severing means **78** should also be clean and should not rust, oxidize or impart corrodents and contaminates (such as moil material) to the loops **22**. A suitable severing means is a wire **78** disposed generally parallel to the axis of the cylinder **60** and roll **62** and spaced from the substrate **24** a distance which is greater than the perpendicular distance from the highest elevation of the solidified loop **22** to the substrate **24**.

Preferably the wire **78** is electrically heated to prevent build-up of the molten material on the severing means **78**, accommodate any cooling of the loops **22** which occurs between the time the loop material leaves the heated pressure bar and severing occurs and to promote lateral stretching of the shank **28**. The heating of the severing means **78** should also provide for uniform temperature distribution in the cross-machine direction, so that an array of loops **22** having substantially uniform geometry is produced.

Generally, as the loop material temperature increases a relatively cooler hot wire **78** temperature severing means can be utilized. Also, as the speed of the substrate **24** is decreased, less frequent cooling of the hot wire **78** occurs as each member **22A** and moil are severed, making a relatively lower wattage hot wire **78** more feasible at the same temperatures. It is not necessary that the severing means **78** actually contact the member **22A** for severing to occur. The member **22** may be severed by the radiant heat emitted from the severing means **78**.

For the embodiment described herein a round cross section nickel-chromium wire **78**, having a diameter of about 0.64 millimeters (0.025 inches) heated to a temperature of about 343° C. to about 440° C. has been found suitable. It will be apparent that a knife, laser cutting or other severing means **78** may be substituted for the hot wire **78** described above.

It is important that the severing means **78** be disposed at a position which allows stretching of the loop material to occur prior to the loop **22** being severed from the moil. If the severing means **78** is disposed too close to the plane of the substrate **24**, the severing means **78** will truncate the shank **28** which will then be too short to form a loop **22**.

A hot wire severing means **78** disposed approximately 3.2 millimeters to 8.3 millimeters (0.125 to 0.325 inches), preferably about 5.7 millimeters (0.225 inches) in the machine direction from the nip point **58**, approximately 1.4 millimeters to 6.5 millimeters (0.056 to 0.256 inches), preferably about 4.0 millimeters (0.156 inches) radially outward from the backing roll **62** and approximately 13.7 millimeters to approximately 18.6 millimeters (0.534 to 0.734 inches), preferably about 16.1 millimeters (0.634

inches) radially outwardly from the print cylinder **60** is adequately positioned for the process of manufacture disclosed herein.

In operation, the substrate **24** is transported in a first direction relative to the depositing member. More particularly, the substrate **24** is transported through the nip **58**, preferentially drawn by a take-up roll (not shown). This provides a clean area of substrate **24** for continuous deposition of loop material and removes the portions of the substrate **24** having the members **22A** and subsequently, via transformation loops **22** deposited thereon. The direction generally parallel to the principal direction of transport of the substrate **24** as it passes through the nip **58** is referred to as the "machine direction". The machine direction, as indicated by the arrows **66** in FIG. **5**, is generally orthogonal the centerline of the print cylinder **60** and backing roll **62**. The direction generally orthogonal to the machine direction and parallel to the plane of the substrate **24** is referred to as the "cross-machine direction".

The substrate **24** may be drawn through the nip **58** at a speed approximately 0% to approximately 10% greater than the surface speed of the cylinder **60** and roll **62**. This is done to minimize bunching or puckering of the substrate **24** near the means for severing **78** the member **22A** from the means for depositing the loop material on the substrate **24**. The substrate **24** is transported through the nip **58** in the first direction at about 3 to about 31 meters per minute (10 to 100 feet per minute).

The angle of the shank **28** formed after severing can be influenced by the rate of transport of the substrate **24** past the nip **70**. If the members **22A** have a shank angle α more nearly perpendicular to the substrate **24**, a slower rate of transport of the substrate **24** in the first direction is preferred. Conversely, if the rate of transport is increased, the angle α of the shank **28** decreases and the distal end **30** having a greater lateral projection **38** will result.

If desired, the substrate **24** may be inclined at any angle α of approximately 35° to approximately 55°, and preferably about 45°, from the plane of the nip **58** towards the backing roll **62** to utilize the viscoelastic nature of the loop material and properly orient the distal end **30** in the "lateral direction", as well as the longitudinal direction, "longitudinal" being defined herein as a direction having a vector component away from the substrate **24**, which direction increases the perpendicular distance of the plane of the substrate **24** at the base **26** of the loop, unless otherwise specified to be a direction having a vector component towards such plane of the substrate. This arrangement also provides a greater force to extract the loop material from the apertures **56** and to pull the loop material away from the print cylinder **60**. The angle α from the plane of the nip **58** should be increased as a lesser angle of the shank **28** is desired. Also, increasing the angle of deviation from the plane of the nip **58** has a weak, but positive effect to produce the distal end **30** having a greater lateral projection.

After depositing loop material from the apertures **56** onto the substrate **24**, the cylinder **60** and roll **62** continue rotation, in the directions indicated by the arrows **66** of FIG. **5**. This results in a period of relative displacement between the transported substrate **24** and the apertures **56** during which period (prior to severing) the loop material bridges the substrate **24** and print cylinder **60**. As relative displacement continues, the loop material is stretched until severing occurs and the member **22A** is separated from the aperture **56** of the print cylinder **60**. As used herein the term "stretch" means to increase in linear dimension, at least a portion of which increase becomes substantially permanent for the life of the female component **20**.

As discussed above, it is also necessary to sever the loop material from the print cylinder **60** as part of the process which forms the distal end **30**. When severed, the member **22A** is longitudinally divided into two parts, a distal end **30** which remains with the female component **20** and a moil (not shown) which remains with the print cylinder **60** and may be recycled, as desired. After the filaments are severed from the moil, the female component **20** is allowed to freeze after the distal end **30** contacts the adjacent loop material or fuses with its own base. After solidification of the members **22A** to thereby form the loops **22**, the substrate **24** may be wound into a roll for storage as desired.

For the illustrated operation described herein and illustrated in FIG. **6**, a print cylinder **60** having an array of about 15 apertures per centimeter (40 apertures per inch) in both the machine direction and cross machine direction, yielding a grid of about 237 apertures per square centimeter (1600 apertures per square inch), is suitable. This grid density may be advantageously used with a print cylinder **60** having a wall thickness of about 0.16 millimeters (0.004 inches) and a diameter of about 20.3 centimeters (8.0 inches), with apertures **56** having a diameter of 0.30 millimeter (0.012 inches). A backing roll **62** having a diameter of about 20.3 centimeters (8.0 inches) and which is vertically registered has been found to work well with the aforementioned print cylinder **60**. The rate of transport of the substrate **24** is about 10.7 meters per minute (35 feet per minute).

A nickel-chromium hot wire **78** having a diameter of about 0.6 millimeters (0.025 inches) disposed approximately 5.7 millimeters (0.225 inches) from the nip **58** in the machine direction, approximately 16.1 millimeters (0.634 inches) radially outward from the print cylinder **60** and approximately 4.0 millimeter (0.156 inches) from the backing roll **62** is heated to a temperature of about 430 degrees Celsius. The female component **20** produced by this operation is substantially similar to that illustrated by FIG. **1**, which female component **20** may be advantageously incorporated into the illustrative article of use discussed below.

As illustrated in FIGS. **7**, **8** and **10**, the loops **22** can be formed to have a variety of different shapes by controlling certain manufacturing parameters such as the print roll geometry, the rotational speed of the print cylinder and backing roll, the hot melt material temperature and the cooling methodology, among others. For example, the loops **22** illustrated in FIG. **7** are formed such that the distal end **30** of one loop **22** fuses with an adjacent loop **22** occurring in the same row **52**. To obtain the loops **22**, the print cylinder **60** as illustrated in FIG. **5** would be operably rotated at a speed of approximately 44 ft./min. and the backing roll **62** would be operated at a speed of approximately 45 ft./min. The hot melt material as described above ideally would be maintained at a temperature of approximately 350° F. Upon depositing the hot melt material on the supporting substrate, the hot wire **70** severs the hot melt material. The hot wire **70** which preferably has a diameter of approximately 0.016 inches need not contact the hot melt material directly, but need only be in sufficiently close proximity to cause the hot melt material to become severed. By disposing the wire **70** approximately 0.140 inches from the nip and 0.395 inches from the print cylinder and operating the print cylinder and backing roll at the speed set forth above, the wire **70** should consistently sever the hot melt material as described thereby resulting in the formation of the loops **22** illustrated in FIG. **7**.

Referring to FIG. **8**, the agglomerated loops **22** are formed by utilizing an apparatus similar to the one illustrated in FIG.

5 and slightly alternating the operating conditions of the apparatus. To form the agglomerated loops **22**, both the print cylinder **60** and the backing roll **62** are operated at a speed of approximately 45 ft./min., and the hot melt material temperature is maintained at a temperature of approximately 340° F., which is slightly cooler than for the embodiment of FIG. **7**. The wire **70** remains 0.140 inches from the nip and 0.395 inches from the print cylinder with a diameter remaining approximately 0.160 inches.

With regard to the embodiment of FIG. **10** which illustrates a plurality of loops **22** formed wherein the distal end **30** fuses back onto the shank **28** or base **26** from which it extends, the operating conditions of the apparatus illustrated in FIG. **5** are again altered slightly. To form the so-called self-fusing loops **22**, the print cylinder **60** is operated at a speed of approximately 45 ft./min. while the backing roll **62** is operated at a speed of approximately 44 ft./min. The hot melt material is again preferably maintained at approximately 360° F. The wire **70** which has a diameter of 0.016 inches is still positioned approximately 0.160 inches from the print cylinder **62**, however it is positioned approximately 0.435 inches away from the nip. To form the self-fusing loops **22** illustrated in FIG. **10A**, the wire **70** is merely moved to approximately 0.180 inches from the print cylinder, with all other parameters essentially remaining the same.

Additionally, referring back to FIG. **2**, it is important to note that both male and female components, **34** and **20**, can be formed on the same substrate **24**. Thus, to make the fastening system **10** of FIG. **2** which mates with a complementary fastener, the apertures **58** provided on the print cylinder **60** are arranged differently for sections of rows **80** which assist in forming loops than for section of rows **82** which assist in forming hooks as illustrated with reference to FIG. **9**. For example, the apertures **58** of row sections **80** which have a diameter of approximately 0.035 inches are typically arranged such that the apertures are disposed in offset linear rows **84** and **84A**, respectively, with a distance of approximately 0.044 inches from the center point of two consecutive apertures in any given row as indicated by reference numeral **86**. Likewise, the approximate distance between the center points of two adjacent apertures provided in adjacent rows, **84** and **84A**, respectively, is also 0.044 inches as indicated by reference numeral **88**. Further, the distance between the center points of two adjacent apertures in alternating offset rows **84** and **84A**, respectively is only about 0.028 inches as indicated by reference numeral **90**.

By way of further example, the apertures **58** of row sections **82** are arranged in staggered and offset rows **92** and **92A**, respectively, while the diameter of each aperture **58** remains approximately 0.035 inches. The distance between center points of consecutive apertures in any given row is increased to approximately 0.088 inches as indicated by reference numeral **94**. Thus, a gap of approximately 0.044 inches occurs between consecutive apertures in any given row. Additionally, while the distance between the center points of adjacent apertures disposed in adjacent rows remains approximately 0.044 inches in the cross machine direction as indicated by reference numeral **96**, the distance between adjacent apertures disposed in adjacent rows is approximately 0.022 inches from their respective center points in the print direction as indicated by reference numeral **98**.

With regard to the processing parameters, a fastening system **10** as illustrated in FIG. **2** can be produced utilizing the aperture arrangement of FIG. **9** by operating the print cylinder **60** at approximately 44 ft./min. and the backing roll **62** at approximately 45 ft./min. Ideally, the hot melt material temperature will be maintained at approximately 350° F with the wire **70** being disposed 0.140 inches from the print cylinder **60** and about 0.395 inches from the nip.

ILLUSTRATIVE ARTICLE OF USE

An illustrative and nonlimiting example of the usage of the fastening system **10** of the present invention in an article of manufacture follows and is illustrated in FIG. **11**. Mechanical fastening systems have been advantageously used in disposable absorbent articles as disclosed in U.S. Pat. No. 4,846,815, filed on Dec. 18, 1987, in the name of Scripps, which reference is incorporated herein by reference for the purpose of showing a diaper **100** structure and the advantageous utilization of mechanical fastening systems **10** in such diaper **100** structures.

It is known, for example, that mechanical fastening systems are less easily contaminated by oils; and powders than are adhesive tape fastening systems and, further, may be easily reused. All of these features provide advantages when applied to a disposable diaper intended for use on an infant. Also, a refastenable fastening system provides the advantage the infant may be checked to see if soiling of the disposable diaper has occurred during the wearing period.

Referring to FIG. **11**, there is shown a disposable diaper **100** intended to be worn about the lower torso by an infant. As used herein, the term "disposable absorbent article" refers to a garment generally worn by infants or incontinent persons and which is drawn between the legs, fastened about the waist of the wearer and intended to be discarded after a single use and not to be laundered or restored. A "disposable diaper" is a particular disposable article intended and scaled to be worn by an infant. Incorporated by reference, some examples of preferred disposable diapers are described in U.S. Pat. Nos. 5,151,092 which issued Sep. 29, 1992, to Buell et al.; 5,242,436 which issued Sep. 7, 1993, to Well et al.; and 3,860,003 which issued Jan. 14, 1975, to Buell et al., all of which are hereby expressly incorporated by reference.

A preferred diaper **100** comprises a liquid pervious topsheet **112**, a liquid impervious backsheet **116**, and an absorbent core **114** intermediate the topsheet **112** and backsheet **116**. The topsheet **112** and backsheet **116** are at least partially peripherally joined to ensure the core **114** is held in position. The diaper **100** elements may be assembled in a variety of configurations well known to one skilled in the art, with preferred configurations being generally described in Buell U.S. Pat. No. 3,860,003 issued Jan. 14, 1975, and Toussant et al. U.S. Pat. No. 4,699,622 issued Oct. 13, 1987, which patents are incorporated herein by reference for the purpose of disclosing particularly preferred diaper configurations.

The topsheet **112** and backsheet **116** of the diaper **100** are generally coextensive and at least partially peripherally joined together as noted above. Joining of the topsheet **112** and backsheet **116** may be accomplished by a hot-melt adhesive, such as Adhesive No. 1258 manufactured by the H.B. Fuller Company of Vadnais Heights, Minn. The absorbent core **114** has length and width dimensions generally less than that of the topsheet **112** and backsheet **116**. The core **114** is interposed between the topsheet **112** and backsheet **116** in a fixed relationship.

The diaper **100** periphery comprises oppositely disposed first and second ends **118** and **118A**. The diaper **100** has a first waist portion **122** and a second waist portion **124** extending respectively from the first end **118** and second end **118A** of the diaper periphery towards the lateral centerline of

the diaper **100** a distance of about one-fifth to about one-third the length of the diaper **100**. The waist portions **122** and **124** comprise those portions of the diaper **100** which, when worn, encircle the waist of the wearer and are generally at the highest elevation of the diaper **100** when the wearer is in the standing position. The crotch **126** of the diaper **100** is that portion of the diaper **100** disposed between the first and second waist portions **122** and **124** and which, when worn is positioned between the legs of the wearer.

The absorbent "core" is any means for absorbing and retaining liquid body exudates. The absorbent core **114** is generally compressible, conformable, and nonirritating to the skin of the wearer. A preferred core **114** has first and second opposed faces and may, if desired, be further encased by tissue layers. One opposed face of the core **114** is oriented towards the topsheet **112** and the other opposed face is oriented towards the backsheet **116**.

The absorbent core **114** is superimposed on the backsheet **116** and preferably joined thereto by any means well known in the art such as adhesive bonding. In a particularly preferred embodiment, the adhesive bonding which joins the core **114** to the backsheet **116** is accomplished by applying adhesive in the form of a spiral. The backsheet **116** is impervious to liquids and prevents liquids absorbed by and contained in the absorbent core **114** from wetting undergarments, clothing, bedding and any other objects which contact the diaper **100**. As used herein, the term "backsheet" refers to any barrier disposed outwardly of the core **114** as the diaper **100** is worn and which contains absorbed liquids within the diaper **100**. Preferably, the backsheet **116** is a polyolefinic film of about 0.025 to about 0.030 mm (0.001–0.0012 inches) in thickness. A polyethylene film is particularly preferred, with suitable films being manufactured by Tredegar Industries of Richmond, Va. and the Clopay Corporation of Cincinnati, Ohio. If desired, the backsheet **116** may be embossed or matte finished to provide a more cloth-like appearance or be provided with passages to permit escape of vapors.

The topsheet **112** is compliant, tactilely pleasing and nonirritating to the wearer's skin. The topsheet **112** prevents contact of the absorbent core **114** and liquids therein with the skin of the wearer. The topsheet **112** is liquid pervious, permitting liquids to readily penetrate therethrough. As used herein, the term "topsheet" refers to any liquid pervious facing which contacts the skin of the wearer while the diaper **100** is being worn and prevents the core **114** from contacting the skin of the wearer. The topsheet **112** may be made of woven, nonwoven, spunbonded or carded materials. A preferred topsheet **112** is a 100% polypropylene nonwoven, carded or spunbonded by means to those skilled in the nonwoven fabrics art. A particularly preferred topsheet **112** has a weight of about 21 to about 24 grams per square meter, a minimum dry tensile strength of about 138 grams per centimeter in the machine direction and a wet tensile strength of at least about 80 grams per centimeter in the cross-machine direction.

The diaper **100** is provided with a fastening system **110** comprising a male component **134** and a female component **136** for maintaining the first waist portion **122** and second waist portion **124** in an overlapping configuration when the diaper **100** is worn, so that the diaper **100** is secured to the wearer. Thus, the diaper **100** is fitted to the wearer and a side closure is formed when the male component **134** is secured to the female component **136**.

The fastening system **110** should resist the separation forces which occur during the wearing period. The term "separation forces" refers to forces acting on the fastening system **110** which tend to cause separation, release or removal of the male component **134** from the female component **136**. Separation forces include both shear and peel forces. The term "shear force" refers to distributive forces acting generally tangential to the female component **136** and which may be thought of as being generally parallel to the plane of the substrate of the female component **136**. The term "peel forces" refers to distributive forces acting in the generally longitudinal direction, and perpendicular to the plane of the female component **136** and male component **134** substrates.

Shear forces are measured by tensile pulling of the male component **134** and female component **136** in opposite directions generally parallel to the planes of the respective substrates. The method used to determine the resistance of a fastening system **110** to shear forces is more fully set forth in Toussant et al. U.S. Pat. No. 4,699,622 issued Oct. 13, 1987, which patent is incorporated herein by reference.

Peel forces are measured by tensile pulling of the male component **134** from the female component **136** at an included angle of about 135°. The method used to determine the resistance of a fastening system **110** to peel forces is more fully set forth in U.S. Pat. No. 4,846,815 filed Nov. 18, 1987, in the name of Scripps, which reference is incorporated herein by reference.

Separation forces are typically generated by movements of the wearer or by the wearer trying to unfasten the diaper **100**. Generally, an infant should not be able to unfasten or remove a diaper **100** the infant is wearing, nor should the diaper **100** come unfastened in the presence of ordinary separation forces which occur during normal wearing. However, an adult should be able to remove the diaper **100** to change it when soiled or check to see if soiling has occurred. Generally, the fastening system **110** should resist a peel force of a least 200 grams, preferably at least about 500 grams, and more preferably, at least about 700 grams. Furthermore, the fastening system **110** should resist a shear force of at least 500 grams, preferably at least about 750 grams, and more preferably at least about 1,000 grams.

The female component **136** may be disposed in a first position anywhere on the diaper **100**, so long as the female component **136** engages the male component **134** to maintain he first and second waist portions **122** and **124**, respectively, in an overlapping configuration. For example, the female component **136** may be disposed on the outside surface of the second waist portion **124**, on the inside surface of the first waist portion **122**, or any other position on the diaper **100** on which it is disposed so as to engage with the male component **134**. The substrate **24** of the female component **136** may be integral, a discrete element joined to the diaper **100**, or a single piece of material that is neither divided or discontinuous with an element of the diaper **100**, such as the topsheet **112** or backsheet **116**.

While the female component **136** may assume various sizes and shapes, the female component **136** preferably comprises one or more integral patches positioned across the outside surface of the second waist portion **124** to allow for maximum fit adjustment at the waist of the wearer. As illustrated in FIG. **11**, the female component **136** is preferably an elongate rectangularly shaped strip integrally secured to the outer surface of the second waist portion **124**.

The female component **136** is intended to be engaged the complementary male component **134** to provide a secure fit for the diaper **100**. The male component **134** may comprise any of the well known configurations utilized for achieving

a side closure on a disposable diaper **100**. The male component **134** substrate is joined to the diaper **100** in spaced relationship from the female component **136**. As shown on FIG. **11**, the male component **134** is preferably disposed on both the first and second longitudinal sides of the diaper **100**. A preferred configuration for the male component **134** minimizes any potential contact between the prongs or hooks of the male component **134** and the skin of the wearer. A preferred male component **134** as illustrated is further described in detail in Buell U.S. Pat. No. 3,848,594 issued Nov. 19, 1974. An alternatively preferred male component **134** arrangement is described in detail in Toussant et al. U.S. Pat. No. 4,699,622 issued Oct. 13, 1987, and still another highly preferred male component arrangement is described in Dennis A. Thomas U.S. Pat. No. 5,230,851 which issued on Jul. 27, 1993, each of the patents being incorporated herein by reference for the purpose of illustrating various placements of the male component **134** on the disposable diaper **100**. A particularly preferred male component **134** disposition is a single tape tab attached to only one side of the diaper. This type of fastening system arrangement is well known in the disposable diaper art and a non-limiting example of this type of fastening system arrangement is described in Scripps U.S. Pat. No. 4,846,815 issued Jul. 11, 1989, which is incorporated herein by reference.

The male component **134** of FIG. **10** has a manufacturer's end **138** and an oppositely disposed user's end **140**. The manufacturer's end **138** is joined to the diaper **100**, preferably in juxtaposition with the first waist portion **122**. The user's end **140** is the free end and is secured to the, female component **136** when the diaper **100** is secured to the wearer.

After the diaper **100** is fitted about the waist of the wearer, the user's end **140** of the male component **134** is reasonably secured to the female component **136**, and preferably positioned on the second waist portion **124**, thereby causing the diaper **100** to encircle the waist of the wearer. The diaper **100** has now effected side closure. The prongs or hooks as shown in FIG. **4** extend from the male component **134** of the user's end **140** so that the prongs or hooks intercept the shanks of the loops contained on the female component **136**.

In use, the diaper **100** is applied to the wearer by positioning the first waist portion **122** around the wearer's back and drawing the remainder of the diaper **100** between the legs of the wearer so that the second waist portion **124** is disposed across the front of the wearer. The user's ends **140** of the male component **134** are then secured to the female component **136** on the outside surface of the second waist portion **124** to form a side closure.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. A fastening system, comprising:

a male component including a plurality of extending hooks;

a female component including a substrate comprising a sheet of flexible material and a multiplicity of female formed loop members deposited onto and joined to said substrate, each of said loop members including:

(a) a base comprising the plane of attachment of said member to said substrate such that said member is joined at said base to said substrate;

(b) a shank having a proximal end and a distal end, said proximal end being contiguous with said base, said shank projecting longitudinally outwardly from said base and said substrate, said distal end fusing with another loop member thereby providing an opening through which at least one of said hooks may project upon fastenably contacting the male and female components.

2. The fastening system of claim **1**, wherein said shank projects nonperpendicularly and longitudinally outwardly from said substrate.

3. The fastening system of claim **1**, wherein said female free formed loops are made from thermoplastic hot melt adhesives.

4. The fastening system of claim **3**, wherein a plurality of loops are joined together, whereby at least two of said joined loops extend from the substrate at varying angles.

5. The fastening system of claim **1**, wherein the extending hooks of said male component include prongs having a generally arcuate profile.

6. A fastening system, comprising:

a male component including a plurality of extending hooks; and

a female component comprising a substrate of flexible material and a multiplicity of free formed loop members deposited onto and joined to said substrate, said loop members including:

(a) a base comprising the plane of attachment of said member to said substrate such that said member is joined at said base to said substrate;

(b) a shank having a proximal end and a distal end, said proximal end being contiguous with said base, said shank projecting longitudinally outwardly from said base and said substrate, said distal end fusing back upon either said shank or said base thereby providing an opening through which at least one of said hooks may project upon fastenably contacting the male and female components.

7. The fastening system of claim **6**, wherein said shank projects nonperpendicularly and longitudinally outwardly from said substrate.

8. The fastening system of claim **6**, wherein said female free formed loops are made from thermoplastic material.

9. The fastening system of claim **7**, wherein said hooks of said male component extend from a substrate at an included angle of between about 270° and 310°.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,586,371

DATED : December 24, 1996

INVENTOR(S) : Dennis A. Thomas

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Column 7, line 52, "20" should be –2.0–.

Column 10, line 61, "Classen" should be –Claasen–.

Column 16, line 19, delete ";".

Column 16, line 38, "Well should be –Weil–.

Column 19, line 32, delete ";".

Signed and Sealed this

Twenty-fifth Day of November, 1997

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

US005643651A

United States Patent [19]

Murasaki

[11] Patent Number: 5,643,651

[45] Date of Patent: Jul. 1, 1997

[54] **MOLDED SURFACE FASTENER AND METHOD FOR MANUFACTURING THE SAME**

[75] Inventor: **Ryuichi Murasaki**, Toyama-ken, Japan

[73] Assignee: **YKK Corporation**, Tokyo, Japan

[21] Appl. No.: **666,602**

[22] Filed: **Jun. 18, 1996**

[30] **Foreign Application Priority Data**

Jun. 20, 1995 [JP] Japan 7-153560

[51] **Int. Cl.**[6] **B32B 3/06**

[52] **U.S. Cl.** **428/100**; 428/138; 428/195; 428/196; 24/442

[58] **Field of Search** 428/100, 138, 428/195, 196, 247, 255; 24/442

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,267,191 8/1966 Williams et al. 264/166
5,520,983 5/1996 Yamamoto et al. 428/100

FOREIGN PATENT DOCUMENTS

0661008A2 7/1995 European Pat. Off. .
5211909 8/1993 Japan .
7-79812 3/1995 Japan .
2160586 12/1985 United Kingdom .

Primary Examiner—Alexander Thomas
Attorney, Agent, or Firm—Hill, Steadman & Simpson

[57] **ABSTRACT**

A plurality of molded surface fasteners, each having a substrate sheet and a multiplicity of hook elements, are connected to one another via a sheet-like connector embedded in the individual substrate sheets over their entire area. In production, a die wheel having a plurality of male-engaging-element-forming cavity groups, which are formed by dividing a plurality of axially arranged rows of cavities with a number of circumferential predetermined-width cavity-free areas disposed therebetween, said cavity groups being for molding the plurality of male engaging elements circumferentially on said die wheel is rotated in one direction, a predetermined width of molten resin is continuously injected from an injection die toward said male-engaging-element-forming cavity groups of said die wheel, a sheet-like connector having adequate open spaces through which said molten resin is to be passed is continuously introduced circumferentially of said die wheel during said injecting, and the circumferential surface of said die wheel are positively cooled.

5 Claims, 7 Drawing Sheets

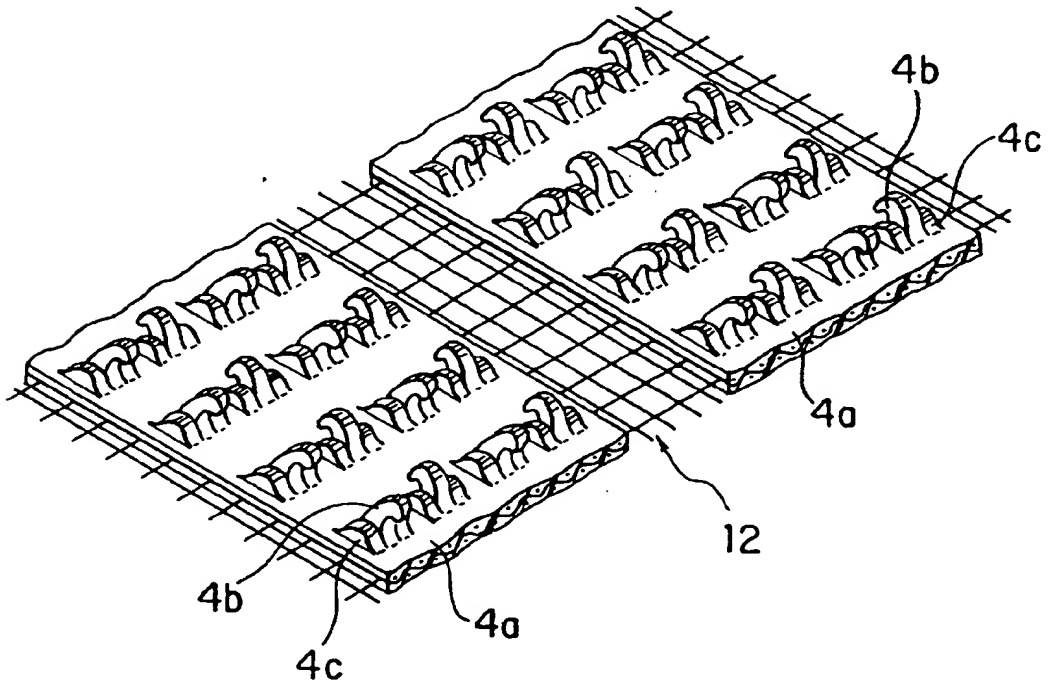


FIG. 1

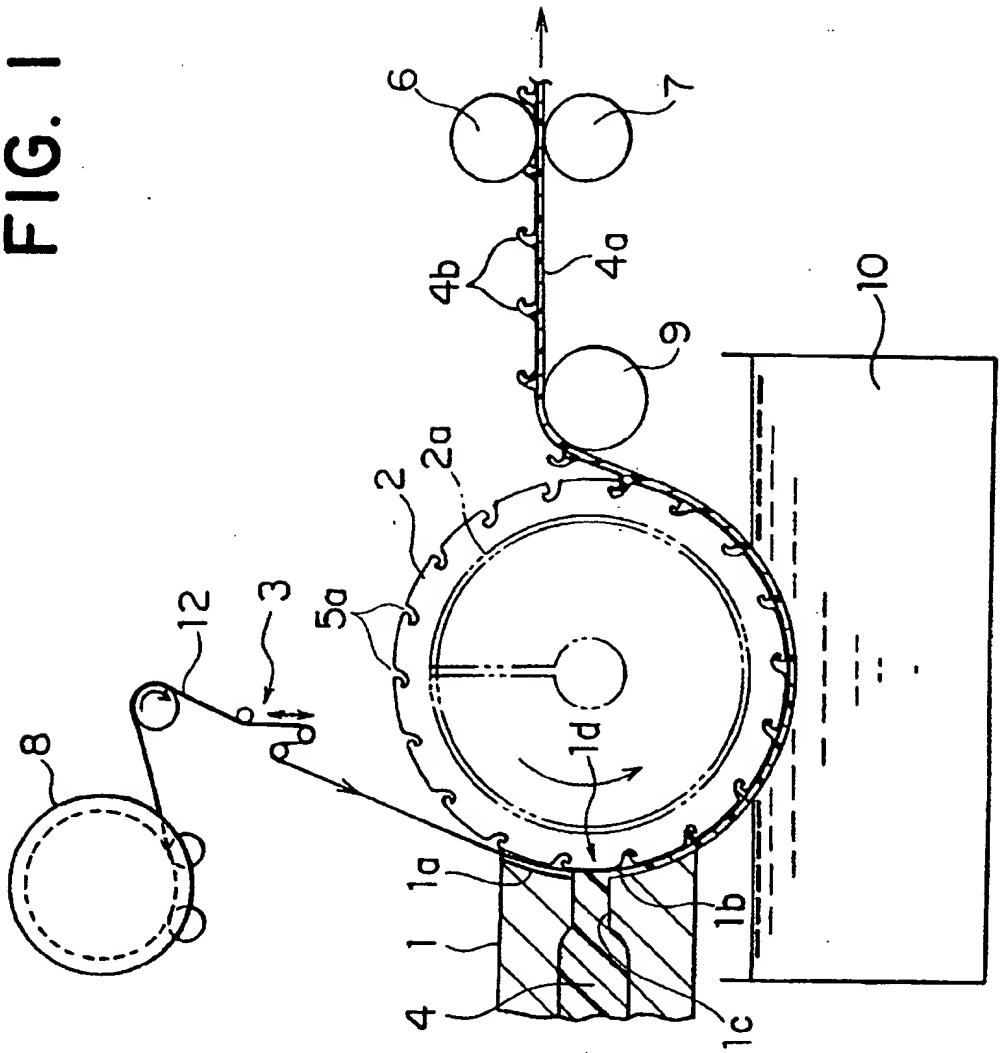


FIG. 2

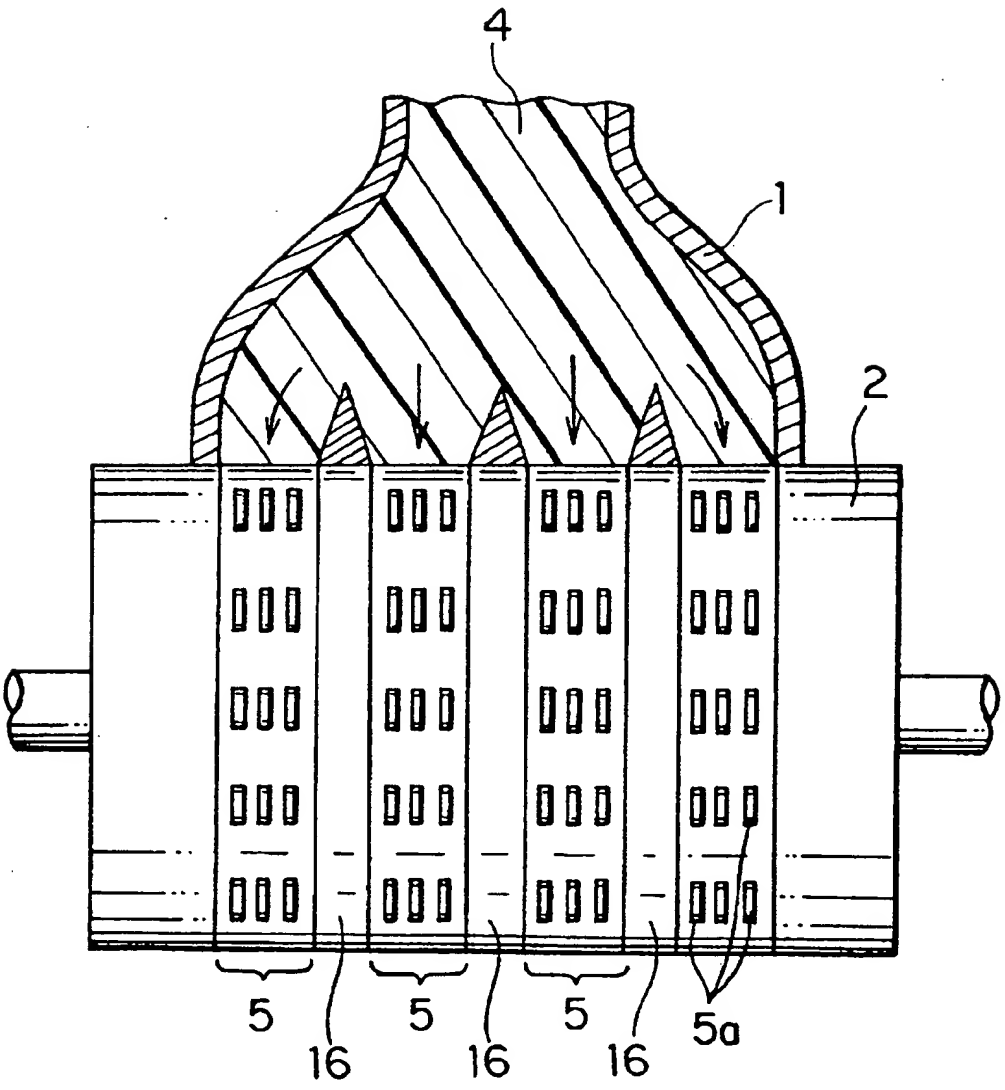
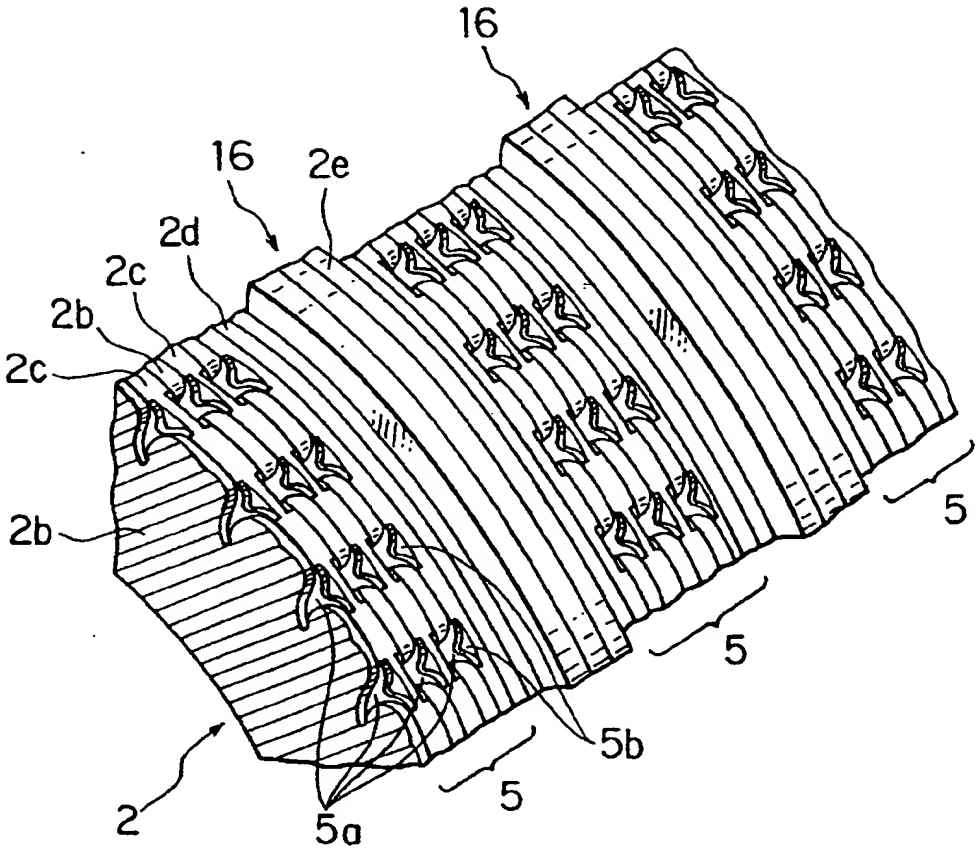


FIG. 3



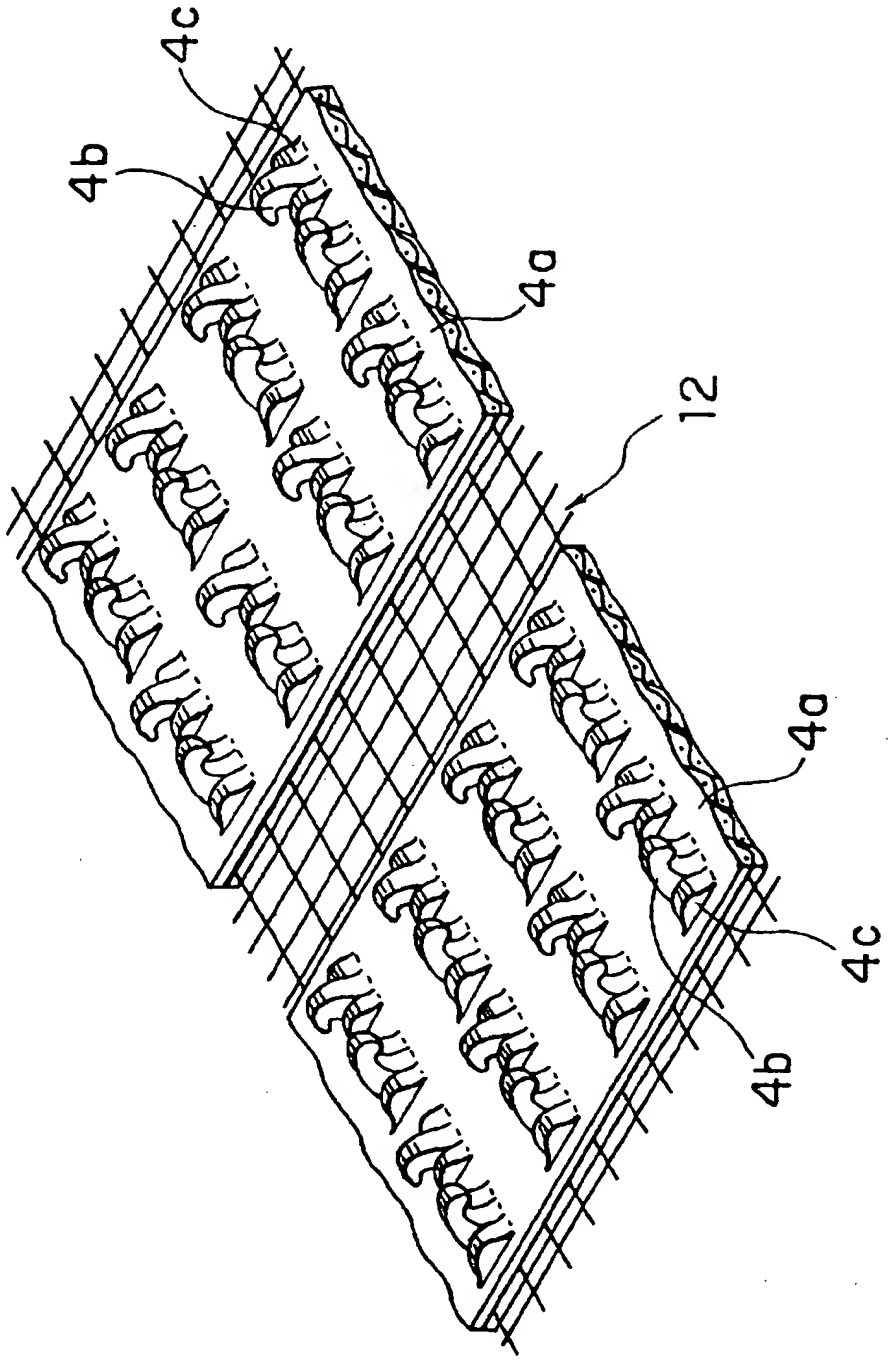


FIG. 4

FIG. 5

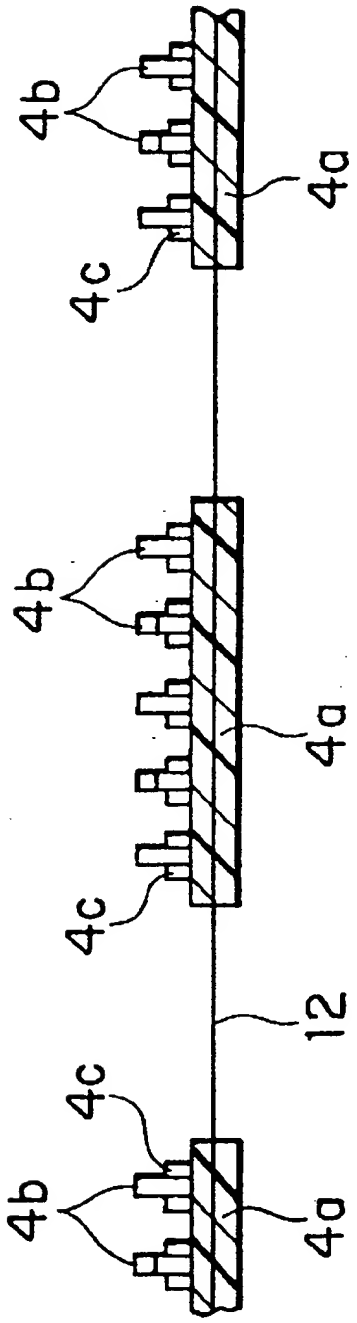


FIG. 6A

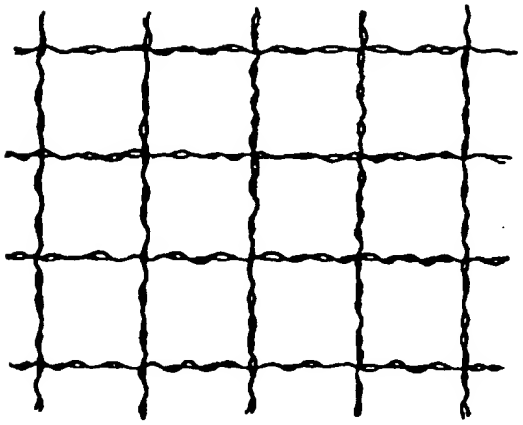


FIG. 6B

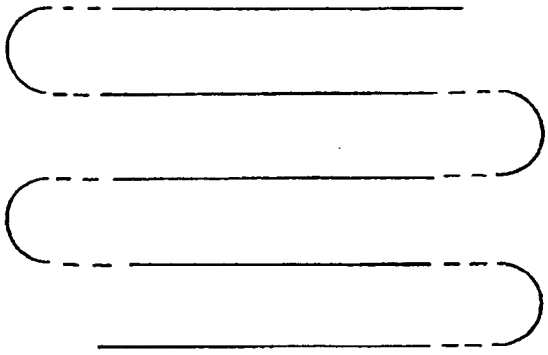


FIG. 6C

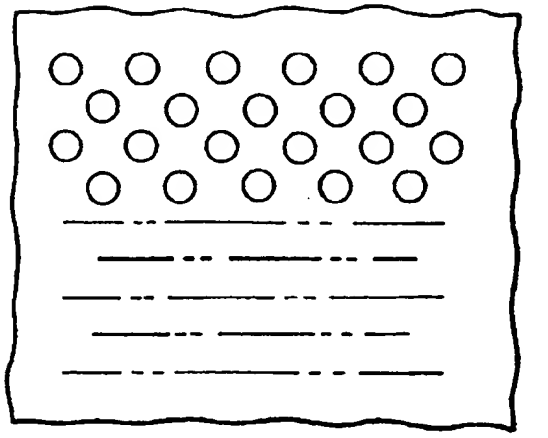
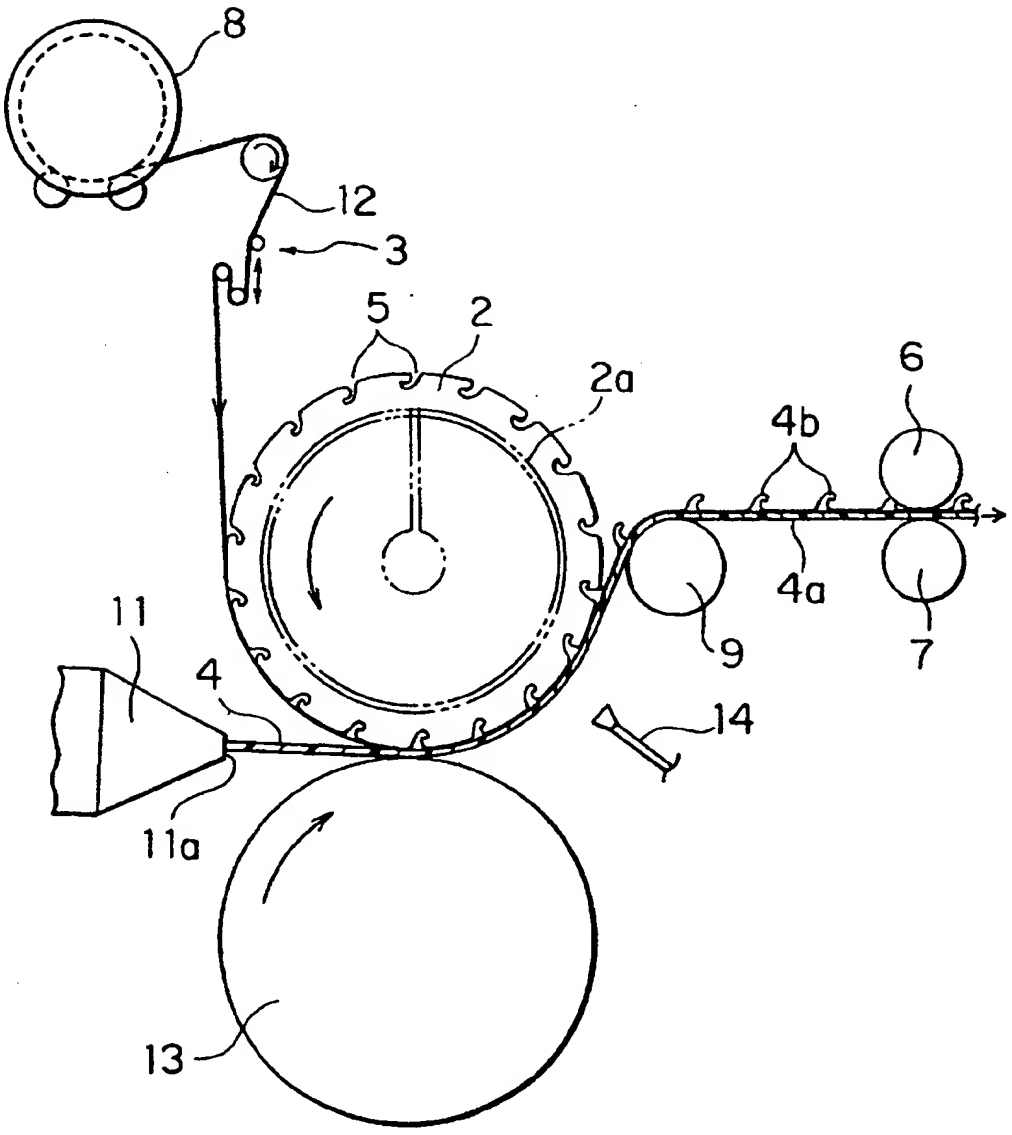


FIG. 7



MOLDED SURFACE FASTENER AND METHOD FOR MANUFACTURING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a molded surface fastener having a multiplicity of male engaging elements integrally molded on one surface of a substrate sheet, continuously molded by injection or extrusion using thermoplastic resin, and more particularly to a molded surface fastener which can hardly be torn in a substrate sheet and is hence very flexible over its entire area.

2. Description of the Related Art

There is currently known a synthetic resin surface fastener in which one surface of a substrate sheet is divided into sections with a plurality of mushroom-shape engaging elements standing from each section and the substrate sheet has a number of grooves or thin portions along borders of the individual sections. This conventional art is exemplified by Japanese Patent Laid-Open Publication No. Hei 7-79812, according to which because of the grooves, the surface fastener can easily be torn along a desired groove to provide a desired width surface fastener and is very flexible along the individual grooves so that it can be attached to fit to various contours of articles.

According to Japanese Patent Laid-Open Publication No. Hei 7-79812, since the substrate sheet simply has the plurality of grooves, when a plurality of subdivided surface fasteners are used as an engaging member as being connected to one another via the individual grooves, the substrate sheet tends to be torn along the individual grooves and is therefore inadequately durable over repeated use.

SUMMARY OF THE INVENTION

A first object of this invention is to provide a molded surface fastener in which a multiplicity of male engaging elements are integrally molded on a substrate sheet, which is divided into a desired number of sections via part of a hard-to-tear sheet-like connector, by injection or extrusion molding using a simple mechanism without reconstructing the conventional molding machine.

A second object of the invention is to provide a molded surface fastener which is adequately flexible and in which a substrate sheet divided into sections has an adequate degree of toughness while connecting areas between the substrate-sheet sections have a predetermined degree of toughness.

Additional objects of the invention will be manifest from the description of preferred embodiments described below.

According to a basic structure of the suffface fastener of the invention, molten resin is passed through a coarse sheet-like connector having spaces enough for the molten resin to pass, so that the substrate sheet divided into a desired number and the male engaging element are molded simultaneously, and at the same time, the connector is embedded in the substrate sheet with the connector connecting the divided substrate sheets.

According to a first aspect of the invention, there is provided a molded surface fastener of synthetic resin, comprising a substrate sheet and a multiplicity of male engaging elements integrally molded with the substrate sheet and standing in rows on one surface of the substrate sheet. The substrate sheet is divided into sections connected to one another via a connector which is smaller in thickness than the substrate sheet and has open spaces through which molten resin is to be passed during the molding of the substrate sheet. The connector is integrally joined with the substrate sheet simultaneously with the molding of the substrate sheet and the male engaging elements.

Preferably, the substrate sheet is divided into two or more sections spaced a predetermined gap from one another transversely of the surface fastener via the connector. Further, the connector is spread transversely of the surface fastener and is composed of a plurality of fiber yarns or metal wires parallel spaced at predetermined distances longitudinally of the surface fastener. Alternatively, the connector may be a coarse woven fabric, knit fabric or metal net having adequate open spaces over its entire area through which molten resin is to be passed during the molding of the substrate sheet. And in another alternative form, the connector may be non-woven cloth, paper or synthetic resin film having adequate open spaces over its entire area through which molten resin is to be passed during the molding of the substrate sheet.

The sheet-like connector to be used in this invention must have over its entire area adequate open spaces through which molten resin can easily be passed. Generally, the molten resin pressure during injection is 50–150 kg/cm^2, acting on the sheet-like connector, The size of the open spaces of the sheet-like connector is preferably larger than 0.25 mm^2 in at least one space area. A desirable size of the open spaces can be obtained by varying the weave or knit density and its structure or the mesh in metal net, varying the pitch of longitudinal arrangement of yarns or metal wires, or varying the area of open spaces in non-woven cloth, paper or synthetic resin film. The thickness of the sheet-like connector sould be determined basically depending on the thickness of the substrate sheet of the surface fastener to be molded and the use of the surface fastener. In order to facilitate molding, it is preferably 10–30% of the substrate sheet thickness. Therefore, the size of fiber yarns or metal wires constituting the sheet-like connector also may be determined as desired depending on the required thickness of the sheet-like connector.

According to a second aspect of the invention, there is provided a method of manufacturing a synthetic resin surface fastener having a substrate sheet and a multiplicity of male engaging elements integrally molded on the substrate sheet, comprising the steps of: rotating in one direction a die wheel having a plurality of male-engaging-element-forming cavity groups, which are formed by dividing a plurality of axially arranged rows of cavities with a number of circumferential predetermined-width cavity-free areas disposed therebetween, the cavity groups being for molding the plurality of male engaging elements circumferentially on the die wheel; continuously injecting a predetermined width of molten resin from an injection die toward the male-engaging-element-forming cavity groups of the die wheel; continuously introducing, during the injecting, circumferentially of the die wheel a sheet-like connector having adequate open spaces through which the molten resin is to be passed; integrally molding the substrate sheet with the sheet-like connector on the circumferential surface of the die wheel and, at the same time, molding the male engaging elements on the circumferential surface of the die wheel as the male-engaging-element-forming cavities are filled with part of the molten resin by injecting the molten resin at a predetermined resin pressure onto the circumferential surface of the die wheel, at a portion where the molten resin is introduced onto the die wheel; positively cooling the circumferential surface of the die wheel; and continuously taking up the molded and cooled surface fastener from the circumferential surface of the die wheel.

According to a third aspect of the invention, there is provided a method of manufacturing a synthetic resin surface fastener having a substrate sheet and a multiplicity of male engaging elements integrally molded on the substrate sheet, comprising the steps of: rotating a die wheel, which has a plurality of male-engaging-element-forming cavity groups which are formed by dividing a plurality of axially arranged rows of cavities with a number of circumferential predetermined-width cavity-free areas disposed therebetween, the cavity groups being for molding the plurality of male-engaging elements circumferentially on the die wheel, and a press roller, which is disposed in confronting relation with and is spaced a predetermined gap from the die wheel, synchronously in mutually opposite directions; continuously extruding molten resin from extrusion die toward the gap between the die wheel and the press roller by a predetermined width against the divided male-engaging-element-forming cavity groups; continuously introducing a sheet-like connector, which has adequate open spaces through which the molten resin is to be passed, toward the gap between the die wheel and the press roller; integrally molding, as the molten resin is pressed by the press roller, the substrate sheet and the connector on the circumferential surface of the die wheel, and at the same time, molding the male engaging elements on the circumferential surface of the die wheel as the divided male-engaging-element-forming cavity groups are filled with part of the molten resin; positively cooling the circumferential surface of the die wheel; and continuously taking up the molded and cooled surface fastener from the circumferential surface of the die wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view, with a part shown in cross-section, schematically showing main part of a typical manufacturing apparatus of a surface fastener of the invention.

FIG. 2 is a fragmentary horizontal cross-sectional view of the apparatus of FIG. 1.

FIG. 3 is a fragmentary enlarged perspective view showing an example of a surface structure of the die wheel which consists the manufacturing apparatus.

FIG. 4 is a fragmentary perspective view of a surface fastener integrally connected by a sheet-like connector, which is a typical embodiment of the invention.

FIG. 5 is a fragmentary horizontal cross-sectional view of the surface fastener.

FIG. 6(A), 6(B) and 6(C) are fragmentary cross-sectional views schematically showing modifications of the sheet-like connector of the invention.

FIG. 7 is a fragmentary cross-sectional view showing another example of manufacturing apparatus of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will now be described in detail with reference to the accompanying drawings.

FIG. 1 is a front view, with a part shown in cross-section, schematically showing an apparatus for manufacturing molded surface fasteners, which are connected by a connector, by injection molding according to a first embodiment of this invention. FIG. 2 is a fragmentary horizontal cross-sectional view of the apparatus.

In FIGS. 1 and 2, reference numeral 1 designates an injection die; the upper half surface of a tip of the injection die 1 is an arcuate surface 1*a* having a curvature substantially equal to that of a die wheel 2 described below, while the lower half surface is an arcuate surface 1*b* having a curvature such that a predetermined gap is defined with respect to a curved circumferential surface of the die wheel 2. The injection die 1 is a T-shape die for continuously injecting molten resin 4 in the form of a sheet under a predetermined resin pressure from an injection nozzle defined centrally between the upper and lower arcuate surfaces 1*a*, 1*b*. In this embodiment, the injection die 1 has a central sprue 1*c*. The injection nozzle is subdivided into a plurality of nozzles 1*d* each having a predetermined width.

The circumferential surface of the die wheel 2 is disposed in part; adjacent to the upper arcuate surface 1*a* of the injection die 1 and is spaced a predetermined gap from the lower arcuate surface 1*b*, with its axis parallel to the injection nozzle tip surface. In the illustrated example, as shown in FIG. 1, the die wheel 2 has in its circumferential suraface a multiplicity of hook-element-forming cavity groups 5 spaced a predetermined gap from one another axially of the die wheel 2. A smooth surface 16 is defined between each pair of adjacent cavity groups 5. These cavity groups 5 are disposed facing the respective subdivided nozzles 1*d*, as shown in FIG. 2.

As the structure of the die wheel 2 is substantially identical with that disclosed in U.S. Pat. No. 4,775,310, it is described only briefly here. The die wheel 2 is in the form of a hollow drum defining a cooling water jacket 2*a* and, as shown in FIG. 3, is composed of a number of ring-shape plates placed one over another about and along its axis. In each cavity groups 5, each of ring-shape plates 2*b* having the same diameter and composing every other plates has in opposite surfaces a multiplicity of hook-element-forming cavities 5*a* with their bases opening to the circumferential surface of the die wheel 2 while each of ring-shape plates 2*c* adjacent to the ring-shape plate 2*b* with hook-element-forming cavities 5*a* has in opposite surfaces a multiplicty of reinforcing-rib-forming cavities 5*b*. A desired number of these ring-shape plates 2*b*, 2*c* are alternately arranged. At one side of each cavity groups, there disposed a desired number of ring-shape plates 2*d* having the same diameter and each having a smooth circumferential surface, and also a desired number of ring-shape plates 2*e* having a diameter equal to the sum of the diameter of the ring-shape plates 2*d* and the thickness of the substrate sheet 4*a* to be formed and having a smooth circumferential surface. The circumferential surface composed of these ring-shape plates 2*e* consists the smooth surface 16.

Thus the ring-shape plates 2*b*, 2*c*, 2*d*, 2*e* form a laminate, and a number of identical laminates are arranged in order about and along the axis of the die wheel 2. The die wheel 2 is driven by a non-illustrated well-known synchronous drive unit for rotation in a direction indicated by an arrow. Accordingly the molten resin 4 injected toward the individual cavity groups 5 facing the respective subdivided nozzles 1*d* does not at all come to the smooth surfaces 16 of the die wheel 2.

In molding the surface fastener in the foregoing embodiment, molten resin 4 is injected as being subdivided, into the gap between the upper arcuate surface 1*a* of the injection die 1 and the circumferential surface of the die wheel 2 toward the individual cavity groups 5. At the same time, a sheet-like connector 12, in the form of a coarse woven or knit fabric or a metal net, drawn from a roll 8 is introduced over the substantially entire width of the hook-element-forming part of the circumferential surface of the die wheel 2 via a tension controller 3. Further, in this

embodiment, a cooling water tank **10** is disposed under the die wheel **2** so that a lower part of the die wheel **2** is soaked in the cooling water tank **10**. A guide roller **9** is disposed diagonally upwardly on the downstream side of the cooling water tank **10**, and further downstream of the guide roller **9**, a vertical pair of take-up rollers **6**, **7** rotatable in synchronism at a speed slightly faster than the die wheel **2** are disposed.

The sheet-like connector **12** may be a coarse woven or knit fabric or a metal net, as shown in FIGS. **4** and **6**(A). In an alternative form, the sheet-like connector **12** may be fiber yarns or metal wires to be successively introduced at predetermined intervals circumferentially of the die wheel **2** and parallel to the axis of the die wheel **2**, as shown in FIG. **6**(B). In this alternative case, the fiber yarns or metal wires are introduced circumferentially of the die wheel **2** as the continuous fiber yarn or metal wire is drawn from a non-illustrated spool and is traversed in round trip parallel to the axis of the die wheel **2** using an ordinary traverse mechanism, or as the previously severed fiber yarns or metal wires are successively supplied parallel to the axis of the die wheel **2** in timed relation to the rotation of the die wheel **2**. The fiber yarns or metal wires may be supplied in such a manner that a plurality of them are simultaneously supplied in a direction of die wheel rotation, having a predetermined space between one another axially of the die wheel. In that case, there provided, in the circumferential surface of the die wheel, regions with the hook-element-forming cavities **5***a* and regions without the hook-element-forming cavities **5***a* circumferentially alternately. The fiber yarns or metal wires may be supplied in both ways as described above simultaneously. Further, the sheet-like connector may be non-woven cloth, paper or synthetic resin film having adequate open spaces through which molten resin is to be passed, as shown in FIG. **6**(C).

The yarns may be natural fiber yarns, monofilaments or multifilament yarns of thermoplastic resin, such as nylon, polyester and polypropylene, or metal wires. Though the material of the fibers should preferably be the same as the thermoplastic synthetic resin of the surface fastener, a different material may be used. Since the size of fibers, fiber yarns and metal wires of the sheet-like connector **12** define the thickness of the sheet-like connector **12**, it is decided depending on the thickness of the substrate sheet **4***a* of the surface fastener and it is preferably 10–30% of the thickness of the substrate sheet **4***a*. In molding surface fasteners, the molten resin temperature, the resin pressure, the die-wheel temperature and the rate of rotation of the die wheel are controlled according to the material of resin to be used. The necessary resin pressure, which depends on the size of open spaces of the sheet-like connector **12**, is generally within a range of 50–150 kg/cm^2, preferably 80–110 kg.cm^2.

For molding the surface fastener of this invention on the foregoing apparatus, molten resin **4** is continuously injected from the injection die **1** under the predetermined resin pressure toward the individual hook-element-forming cavity groups **5** on the circumferential surface of the die wheel **2** in rotation. At the same time, part of the sheet-like connector **12** which is introduced simulatenously and the molten resin **4** are joined together, and a multiplicity of hook elements **4***b* are successively molded in timed relation to the rotation of the die wheel **2** as the individual hook-element-forming cavity groups **5** in the circumferential surface of the die wheel **2** are filled with part of molten resin **4** via the open spaces of the sheet-like connector **12**. Meanwhile a number of substrate sheets **4***a* in which part of the sheet-like connector **12** is embedded and which are connected to one another by the sheet-like connector **12** are integrally molded in a predetermined thickness.

The molten resin **4** shaped into the form of a surface fastener on the circumferential surface of the die wheel **2** together with the sheet-like connector **12** is moved around substantially a lower half of the circumferential surface of the die wheel **2** as guided by the guide roller **9**. During that time, the hook elements **4***b* and the substrate sheets **4***a* in which part of the sheet-like connector **12** is embedded are gradually solidified as the molten resin **4** is cooled partly from the inside of the die wheel **2** and partly in the cooling water tank **10**. During this solidification, the substrate sheets **4***a* are positively drawn horizontally by the take-up rollers **6**, **7**. When the individual hook elements **4***b* are smoothly removed from the cavities **5***a*, **5***b* as being resiliently deformed, they restore their original shape immediately after having been removed from the die wheel **2** and are completely solidified. As a result, a surface fastener with the stable shape can be obtained.

In this embodiment, in order to remove a molded resin product (i.e., a connector-embedded surface fastener) from the die wheel **2**, the vertical pair of take-up rollers **6**, **7** rotatable in opposite direction in synchronism with each other are used. Although the circumferential surfaces of the take-up rollers **6**, **7** may be smooth, it is preferable that they have grooves for passage of hook-element rows so that the hook elements **4***b* are kept free from damage. The speed of rotation of the take-up rollers **6**, **7** is set at a value slightly higher than the speed of rotation of the die wheel **2** so that the hook elements **4***b* can be smoothly removed from the hook-element-forming cavity groups **5**.

In the thus manufactured surface fastener, since a plurality of substrate sheets **4***a* are connected to one another by a coarse sheet-like connector **12** part of which is embedded in the substrate sheets **4***a* as shown in FIGS. **4** and **5**, the substrate sheets **4***a* has an adequate degree of toughness and is flexible along part of the sheet-like connector **12** so that the surface fastener can be attached reliably fit to any of various contours of articles and can be kept free from any inconvenience such as tear due to the sewing needle during sewing. Further, the surface fastener can be cut between a desired adjacent pair of substrate sheets **4***a* along the connector **12**, if neccessary.

FIG. **7** is a vertical cross-sectional view showing an apparatus for manufacturing a connector-embedded surface fastener by continuous extrusion molding according to a second embodiment of this invention.

In this embodiment, an extrusion die **11** is used instead of the injection die **1** of the foregoing embodiment, and a press roller **13** is disposed under the die wheel **2** having a structure substantially identical with the one described above with a predetermined gap therebetween. A nozzle of the extrusion die **11** is divided into the same number of nozzles **11***a* as that of the hook-element-forming cavity groups **5** and each of the subdivided nozzles **11***a* faces the respective hook-element-forming cavity groups **5** for extruding molten resin **4** toward the gap between the die wheel **2** and the press roller **13**. As a most significant feature of this embodiment, in the circumferential surface of the die wheel **2**, the hook-element-forming cavities **5***a* together with the substrate-sheet-forming portions are divided into a number of groups or sections, and the sheet-like connector **12** is introduced into the gap between the molten resin **4** extruded from the extrusion die **11** and the circumferential surface of the die wheel **2**. Specifically, in this illustrated embodiment, a sheet-like connector **12** having a width substantially equal to

the molding width of the die wheel **2**, together with the molten resin **4** extruded from the subdivided nozzles **11***a* of the extrusion die **11**, is introduced into the gap between the die wheel **2** and the press roller **13**. Likewise in the foregoing embodiment, inside the die wheel **2**, a cooling water jacket **2***a* for cooling the circumferential surface of the die wheel **2** from inside is mounted. A cooling air blower **14** is disposed to blow a cooling air toward the circumferential surface of the die wheel **2** after the latter bas passed a position of a pressure surface with the press roller **13**. The die wheel **2** and the press roller **13** are driven by a non-illustrated drive unit to rotate in opposite directions, as indicated by arrows in FIG. **4**, in synchronism with each other.

A guide roller **9** is disposed diagonally upwardly on the downstream side of the cooling air blower **14**, and a vertical pair of take-up rollers **6**, **7** rotatable in opposite directions at a speed slightly faster than the rotation of the die wheel **2** is disposed on the downstream side of the guide roller **9**.

According to the apparatus of the second embodiment, the molten resin **4** extruded from the subdivided nozzles **11***a* of the extrusion die **11**, together with the sheet-like connector **12** introduced circumferentially of the die wheel **2**, is introduced into the gap between the die wheel **2** and the press roller **13**. The molten resin **4** is then forced into the individual hook-element-forming cavity groups **5** through the open spaces of the sheet-like connector **12** under the pressure by the press roller **13**. A single sheet-like connector **12** to be introduced into the above-mentioned gap circumferentially of the die wheel **2** is embedded in the individual substrate-sheets **4***a* corresponding to the respective hook-element-forming cavity groups **5**, thereby connecting the substrate-sheets **4***a* to one another. The resulting surface fastener is moved around substantially a quarter of the circumferential surface of the die wheel **2** and is then continuously removed from the circumferential surface of the die wheel **2** as positively taken by the take-up rollers **6**, **7** via the guide roller **9**.

During that time, the surface fastener is gradually cooled by the cooling means **2***a* inside the die wheel **2** and by the cooling air blower **14** and is thereby solidified. In this embodiment, if the sheet-like connector **12** to be introduced into the gap between the die wheel **2** and the press roller **13** is previously heated to eliminate a difference of temperature with the substrate sheet **4***a* in semimolten state, it would be fused with the substrate sheet **4***a* more reliably.

Also in the second embodiment, the individual hook element **4***b* has a pair of reinforcing ribs **4***c* on opposite side surfaces; the hook elements **4***b* in the same row are directed in a common direction, and the book elements **4***b* in adjacent rows are directed in opposite directions. The reinforcing rib **4***c* may be omitted, but the reinforcing ribs **4***c* are effective to prevent the hook elements **4***b* from falling flat laterally. Alternatively, the hook elements **4***b* successive in a row may be directed alternately in opposite directions so that a surface fastener having no directivity in engaging strength can be obtained. This invention should by no means be limited to the illustrated example, and various modifications may be suggested without departing from the sprit of this invention.

As is apparent from the foregoing description, according to the molded surface fastener of this invention, since the substrate sheet **4***a* with hook elements **4***b* is divided into a number of sections via the sheet-like connector **12**, the surface fastener has an adequate degree of flexibility along part of the sheet-like connector **12** and can be reliably and easily attached to fit to any of various contours of articles. By cutting the sheet-like connector **12** between a desired adjacent pair of subdivided substrate-sheets **4***a*, it is possible to obtain a desired width of surface fastener. Further, since the sheet-like connector **12** is embedded in the substrate sheet **4***a* over its entire area, it is possible to secure an adequate degree of toughness of the substrate sheet **4***a*, making the surface fastener durable for repeated use.

Further, according to this invention, a molded surface fastener can be continuously manufactured efficiently and economically in a single process with only minor modifications to the well-known injection molding or extrusion molding.

The molded surface fastener of this invention can be molded by a common injection molding machine.

What is claimed is:

1. A molded surface fastener of synthetic resin, comprising:

(a) a substrate sheet;

(b) a multiplicity of male engaging elements integrally molded with said substrate sheet and standing in rows on one surface of said substrate sheet; and

(c) said substrate sheet being divided into sections connected to one another via a connector, said connector being smaller in thickness than said substrate sheet and having open spaces through which molten resin is to be passed during the molding of said substrate sheet;

(d) said connector integrally joined with said substrate sheet simultaneously with the molding of said substrate sheet and said male engaging elements.

2. A molded surface fastener according to claim **1**, wherein said substrate sheet is divided into two or more sections spaced a predetermined gap from one another transversely of said surface fastener via said connector.

3. A molded surface fastener according to claim **2**, wherein said connector is spread transversely of said surface fastener and is composed of a plurality of fiber yarns or metal wires parallel spaced at predetermined distances longitudinally of said surface fastener.

4. A molded surface fastener according to claim **2**, wherein said connector is a coarse woven fabric, knit fabric or metal net having adequate open spaces over its entire area through which molten resin is to be passed during the molding of said substrate sheet.

5. A molded surface fastener according to claim **2**, wherein said connector is non-woven cloth, paper or synthetic resin film having adequate open spaces over its entire area through which molten resin is to be passed during the molding of said substrate sheet.

* * * * *

US005669120A

United States Patent [19]

Wessels et al.

[11] Patent Number: 5,669,120

[45] Date of Patent: Sep. 23, 1997

[54] **MOLDED SURFACE FASTENER**

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[73] Assignee: **YKK Corporation**, Tokyo, Japan

[21] Appl. No.: **730,846**

[22] Filed: **Oct. 17, 1996**

Related U.S. Application Data

[63] Continuation of Ser. No. 437,930, May 9, 1995, abandoned.

[51] **Int. Cl.**[6] **A44B 13/00**; B29C 41/30

[52] **U.S. Cl.** **24/446**; 264/167; 24/445; 24/452

[58] **Field of Search** 24/306, 442–452, 24/575–578; 204/167

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,387,345	6/1968	Savoir	24/446
3,399,425	9/1968	Lemelson .	
3,555,630	1/1971	Wylde	24/447
3,594,863	7/1971	Erb .	
3,594,865	7/1971	Erb .	
3,608,035	9/1971	Fröhlich .	
3,758,657	9/1973	Menzin et al.	264/167 X
4,541,154	9/1985	Ito et al.	24/446 X
4,592,118	6/1986	DeWoskin	24/444
4,654,246	3/1987	Provost et al.	428/88
4,931,344	6/1990	Ogawa et al.	24/444 X
4,999,067	3/1991	Erb et al.	24/444 X
5,142,743	9/1992	Hahn	24/442 X
5,231,738	8/1993	Higashinaka	24/446
5,260,015	11/1993	Kennedy et al.	264/167
5,369,852	12/1994	Higashinaka	24/446
5,393,475	2/1995	Murasaki et al.	264/167 X
5,441,687	8/1995	Murasaki et al.	264/167
5,512,234	4/1996	Takizawa et al.	264/167 X
5,518,795	5/1996	Kennedy et al.	24/306 X

FOREIGN PATENT DOCUMENTS

0580 073 A2	1/1994	European Pat. Off. .
0 581 570 A2	2/1994	European Pat. Off. .
2017 522	12/1971	Germany .
1166935	10/1969	United Kingdom .

Primary Examiner—Peter M. Cuomo
Assistant Examiner—Robert J. Sandy
Attorney, Agent, or Firm—Hill, Steadman & Simpson

[57] **ABSTRACT**

In a molded surface fastener, at least part of a substrate sheet and hook elements are molded of synthetic resin, and simultaneously with the molding of the substrate sheet, at least part of foundation structure of a pile woven or knit core sheet is integrated with the substrate sheet which is molded of synthetic resin in such a manner that loop elements in the form of piles standing from the pile woven or knit core sheet are exposed to the front surface of the substrate sheet. The height of the hook elements is greater than that of the loop elements, and the foundation structure of the pile woven or knit core sheet is a coarse woven or knit structure having adequate pores throughout its entire area to allow molten resin to pass through. The hook elements and loop elements stand on the same surface or either of the front and back surfaces of the substrate sheet.

6 Claims, 6 Drawing Sheets

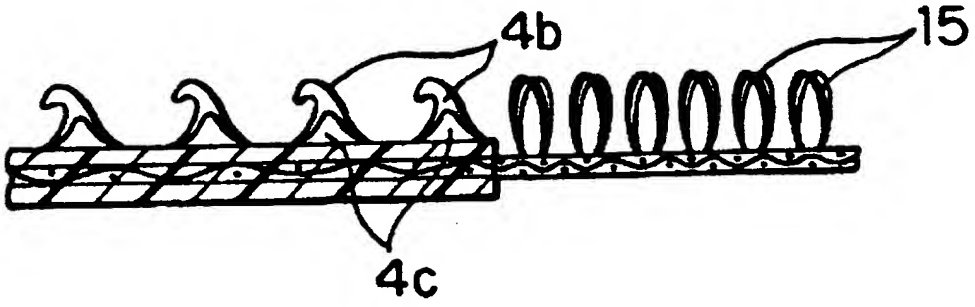


FIG. 1

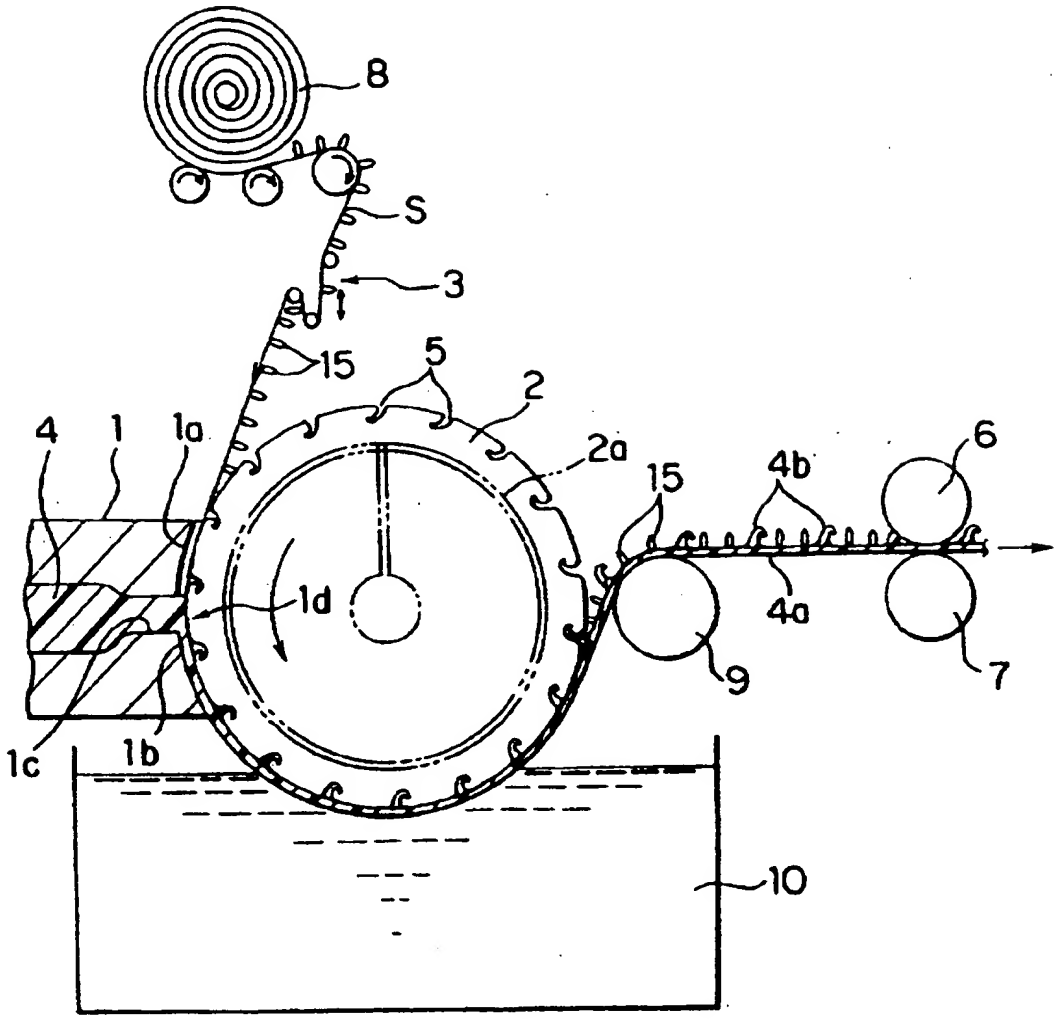


FIG. 2

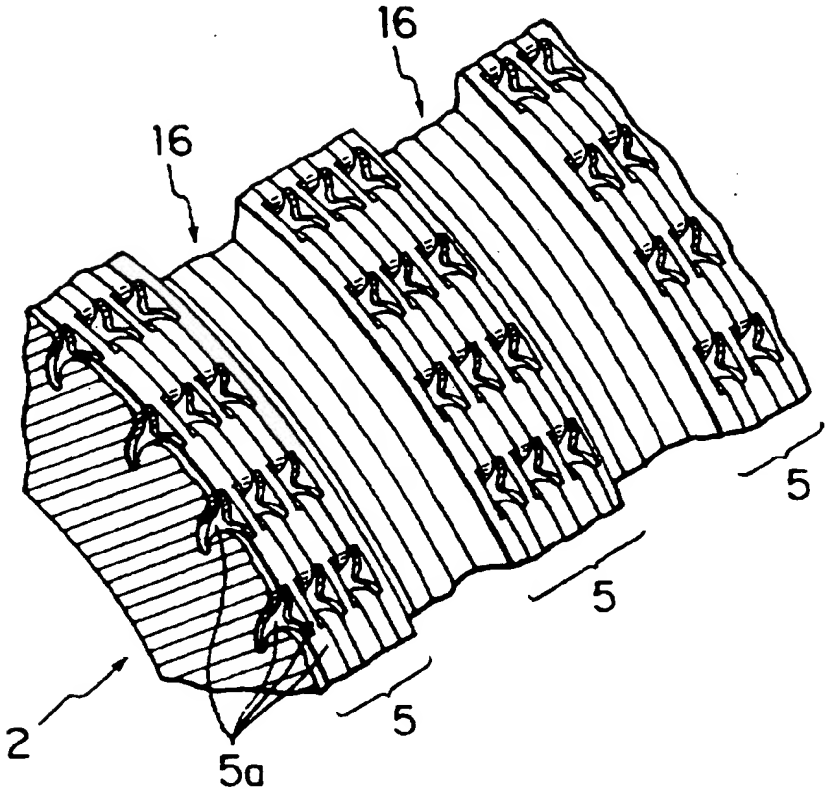


FIG. 3

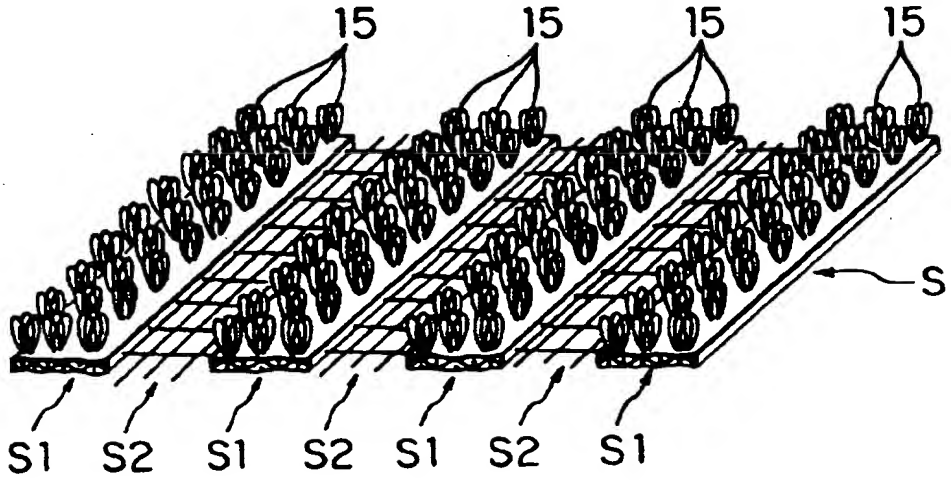


FIG.4A

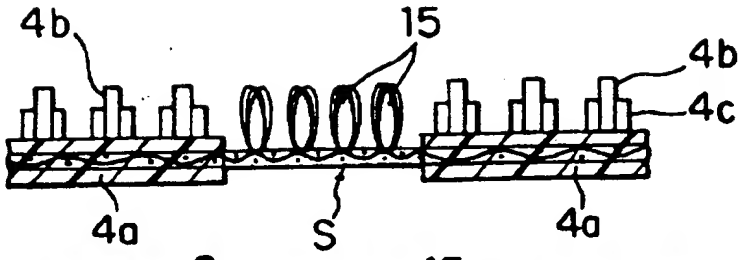


FIG.4B

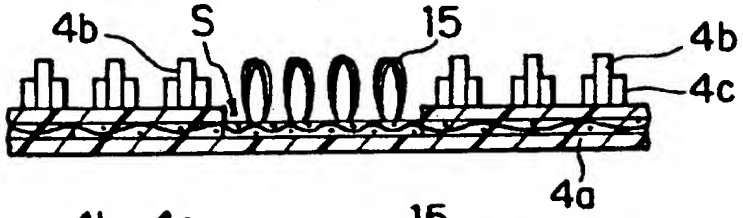


FIG.4C

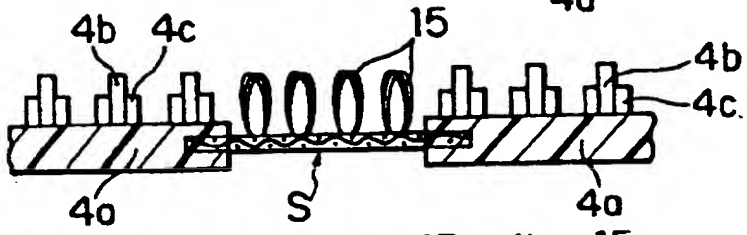


FIG.4D

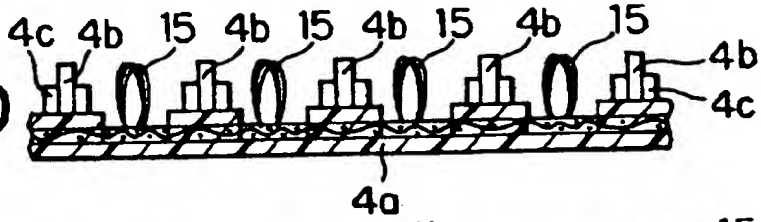


FIG.4E

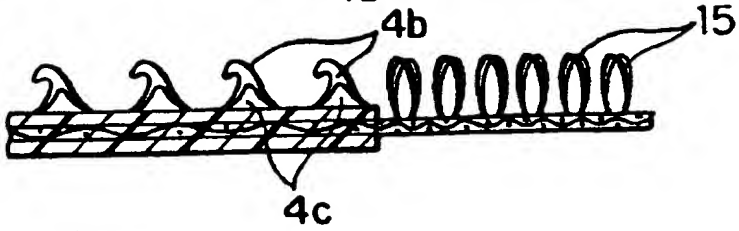


FIG.4F

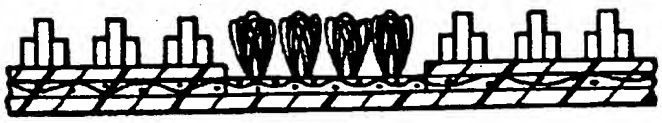


FIG. 5

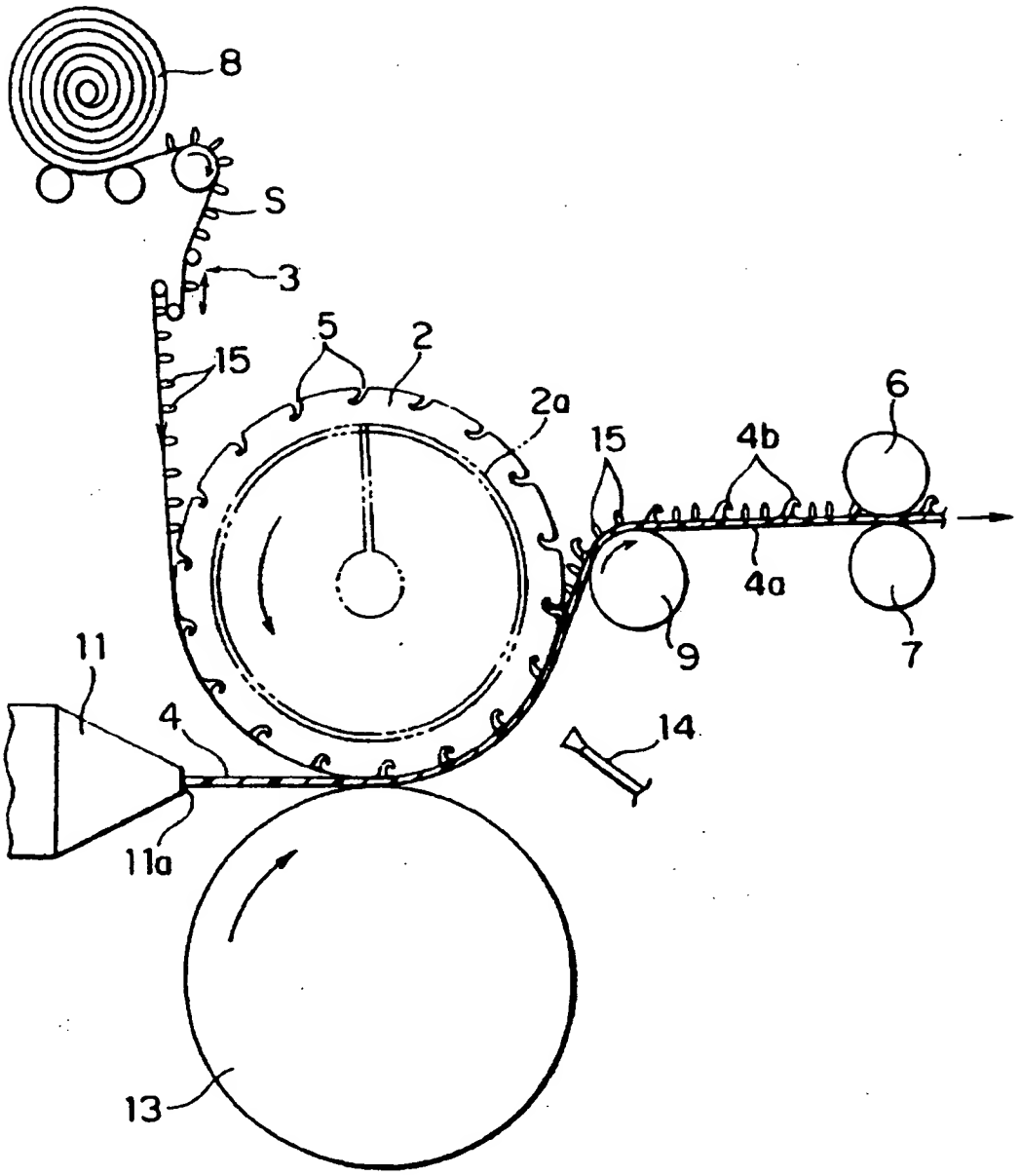


FIG. 6

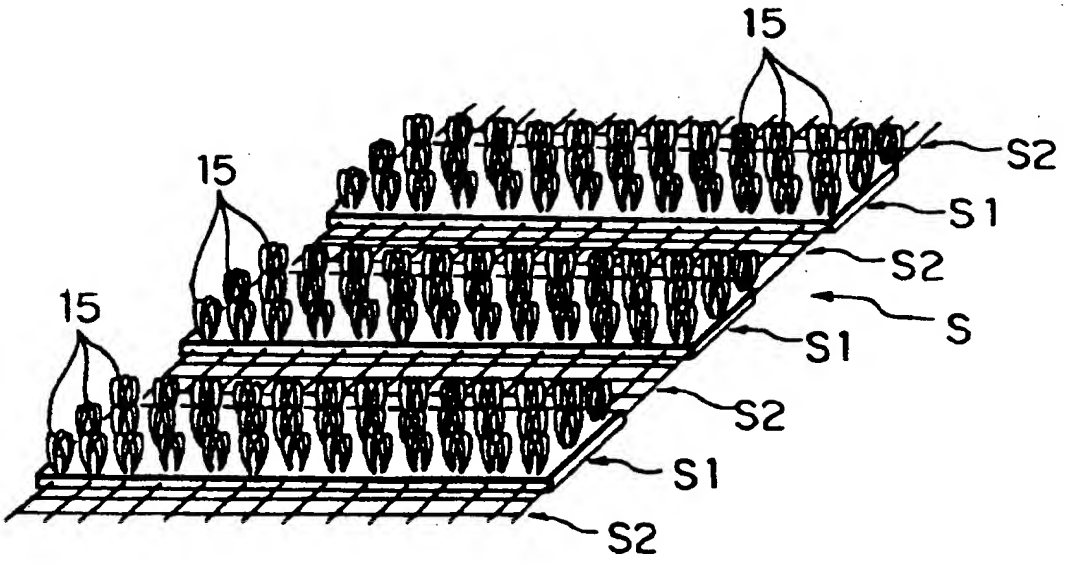


FIG. 7

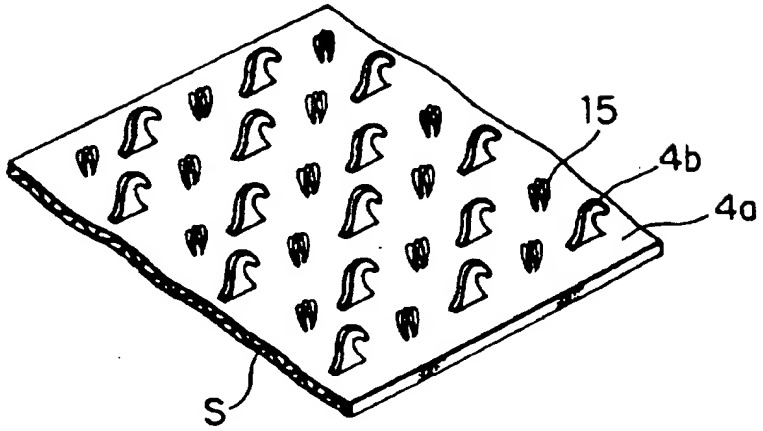


FIG. 8

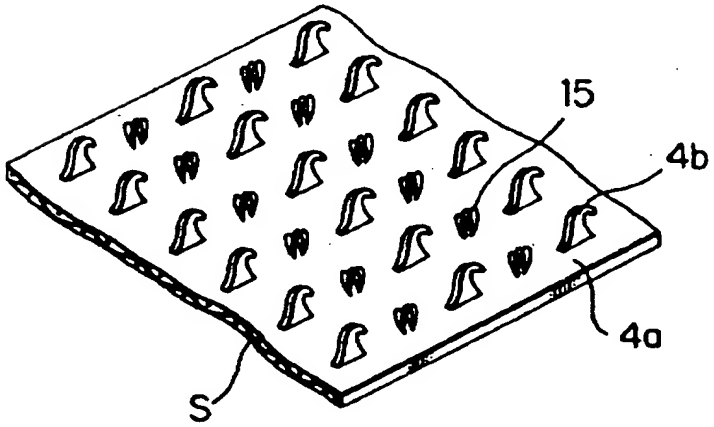
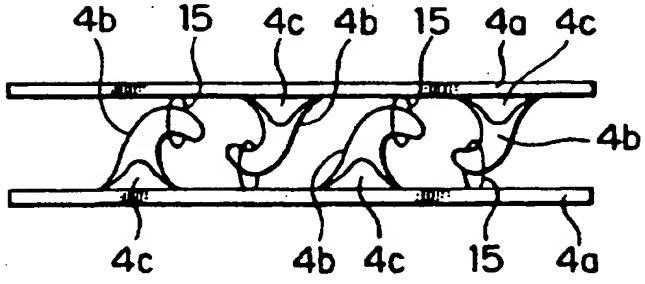


FIG. 9



MOLDED SURFACE FASTENER

This is a continuation of application Ser. No. 08/437,930, filed May 9, 1995, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a surface fastener molded of thermoplastic resin by continuous injection or extrusion and having a plate-like substrate sheet and a multiplicity of engaging elements standing on one or both surfaces of the plate-like substrate sheet, and more particularly to a molded surface fastener in which a multiplicity of molded male engaging elements of synthetic resin and a multiplicity of female engaging elements in the form of fiber piles stand from one or both surfaces of the substrate sheet.

2. Description of the Related Art

A surface fastener is currently known in which a multiplicity of hook- or mushroom-shape engaging elements of a monofilament and a multiplicity of loop elements of multifilaments mixedly stand from one surface of a substrate cloth. This conventional art is exemplified by U.S. Pat. No. 5,231,738, in which the hook- or mushroom-shape engaging elements have a height less than the height of the loop elements in an effort to secure a desired rate of engagement and a good touch of the engaging surface.

According to the invention disclosed in U.S. Pat. No. 5,260,015, molten thermoplastic resin is extruded to the gap between a rotating drum-shape die wheel, in which a multiplicity of mold disks and a multiplicity of spacer plates are laminated alternately, and a press roller, and a core sheet having a multiplicity of piles is introduced between the extruded resin and the press roller. As the core sheet is thus introduced, part of the resin is penetrated into the core sheet by the pressing force of the press roller to integrate with the substrate and, at the same time, part of the resin is filled in hook-element-forming circumferential cavities of the die wheel to mold a multiplicity of hook elements. The resulting surface fastener, in which the core sheet is integrally attached to the substrate at its back surface opposite to the hook surface, is cooled while traveling through a predetermined angle along the circumferential surface of the die wheel following the rotation of the die wheel, whereupon the molded hook elements are pulled out of the cavities and, at the same time, the substrate is continuously peeled off the circumferential surface of the die wheel.

With the surface fastener disclosed in U.S. Pat. No. 5,231,738, partly since the substrate is a cloth made of synthetic resin fibers or metal fibers and partly since the hook- or mushroom-shape engaging elements and the loop elements standing from the substrate are also made of fiber material, its production needs mainly the fiber processing technology requiring a large number of meticulous steps, which raises the cost of product. Moreover, in the surface fastener with male and female elements distributed mixedly, the male and female engaging elements are formed at the time of weaving or knitting as described above. However, though it is desirable to give a napping process to the loop elements which consists female engaging elements in order to improve the engaging rate of the loop elements, it is impossible to give the napping process to a surface where male engaging elements are distributed. Therefore, the form of the loop elements cannot be changed before nor after the weaving or knitting.

Further, since its basic structure is composed of fibers, the engaging force of this prior surface fastener is limited. As

application of this type surface fastener has been expanded in recent years to a wide variety of fields, for example, from industrial material fasteners requiring a relatively great engaging force to paper diaper fasteners requiring adequate softness and low price, the number of functions of the modern fasteners are on the rise. The above-mentioned surface fastener composed of fiber material could hardly meet such expanded variety of requirements.

On the other hand, in the surface fastener disclosed in U.S. Pat. No. 5,260,015, not only since the core sheet having piles is located in the substrate necessarily eccentrically toward its back side, but also since the piles are pressed by the press roller toward the circumferential surface of the die wheel to be integrally attached to the substrate surface which is formed of molten resin, the function of piles tends to be impaired. In order to prevent this problem, a pile supporting portion, i.e. the core sheet, needs such a high density not to allow molten resin to pass through. In this case, merely by that a part of molten resin of the substrate penetrates into the back side of the pile supporting portion to the core sheet is fused integrally therewith.

However, according to the manufacturing method disclosed in U.S. Pat. No. 5,260,015, the surface fastener in which the core sheet is embedded in the substrate eccentrically toward the back side is revolved through a predetermined angle along the circumferential surface of the die wheel in one-way rotation and is then positively peeled off the circumferential surface of the die wheel under a predetermined tension. Even in the case where the core sheet is not attached, since the hook elements molded in the hook-element-forming circumferential cavities of the die wheel have to be positively removed, the substrate is stretched as a relatively great pulling force is exerted on the substrate, apart from any deformation of the hook elements. Accordingly, in the core-sheet-free surface fastener, the substrate is stretched substantially uniformly on both the front and back sides. Whereas in the case of the surface fastener containing the core sheet, when the surface fastener molded on the circumferential surface of the die wheel is positively peeled off, the substrate is less extendible at the back side, where the core sheet exists, and is more extendible at the front side, where the hook elements exist. Therefore, after completion of the molding, the surface fastener has different lengths at the front and back sides so that the surface fastener is curved convexly at the hook-element side and it is difficult to control the coefficient of extension of the front side, thus resulting in a non-uniform density of hook elements. In use, it is not only inconvenient when such surface fastener is attached to an objective good, but also a constant rate of engagement cannot be achieved to impair the quality of product.

SUMMARY OF THE INVENTION

With the foregoing problems in view, it is a first object of this invention to provide a high-quality surface fastener, on which molded hook elements and loop elements made of fibers are mixedly distributed, which is stable in shape as being extrusion- or injection-molded using a simple molding apparatus without any reconstruction.

A second object of the invention is to secure an adequate degree of toughness of the hook-element side of a plate-like substrate sheet of the surface fastener and to realize a highly precise density of hook elements.

A third object of the invention is to provide a molded surface fastener in which loop elements made of fibers and molded hook elements coexist, with the loop elements being given the napping process.

According to this invention, there is provided a surface fastener molded of synthetic resin, comprising: a plate-like substrate sheet, a multiplicity of hook elements, and loop elements. In this surface fastener, the hook elements are molded of a synthetic resin material integrally on one surface of the plate-like substrate sheet, and the loop elements are composed of piles projecting from a pile woven or knit cloth. And at least part of a foundation structure of the pile woven or knit cloth is formed integrally with the substrate sheet simultaneously with the molding of the substrate sheet.

Preferably, the height of the hook elements is greater than the height of the loop elements unlike the conventional surface fastener disclosed in U.S. Pat. No. 5,231,738 in which the hook elements are shorter than the loop elements. In the surface fastener of this invention, since the hook elements are molded of synthetic resin and not formed of monofilaments, the individual hook element has at its top a smoothly curved surface with no rough touch and is highly stable in shape, so that hook elements are easy to engage the loop elements in spite of the short loop elements as shown in FIG. 9 and the gap between the mating substrate sheets can be reduced to a minimum during engaging.

Further, in the surface fastener of this invention, the foundation structure of the pile woven or knit cloth is a coarse woven or knit structure having pores large enough to pass molten resin material throughout its entire area, and the hook and loop elements exist mixedly on the one surface of the substrate sheet. In an alternative form, the foundation structure of the pile woven or knit cloth is high in density at its pile areas and has a coarse woven or knit structure at the remaining areas coarse enough to pass molten resin material. Further, the hook elements and the loop elements may be arranged alternately in parallel predetermined regions on the one surface of the substrate sheet.

The pile woven or knit cloth to be used in this invention must have adequate pores for the passage of molten resin. Usually, a molten resin pressure of 50–150 kg/cm^2 acts on the pile woven or knit cloth during the continuous injection. The size of the pores in the cloth which allows the molten resin to smoothly pass through under this resin pressure is preferably at least 0.05 mm. A desired mesh size may be obtained by changing the weave density and/or woven structure if the cloth is a woven cloth, the knit density and/or knit structure if it is a knitted cloth, and the mesh if it is a wire net. The thickness of foundation structure of the pile woven or knit cloth is determined by the thickness of the substrate sheet of the surface fastener to be molded and its use; in view of facilitation of molding, however, the thickness of the foundation structure is preferably 20–60% of that of the substrate sheet. Accordingly, the size of yarns, wires or fibers of the foundation structure may be determined optionally by the required thickness of the foundation structure.

And it is advantageous that, in this invention, it is possible to treat a pile surface of the pile woven or knit core sheet having the aforesaid structure with the napping process before integral molding with the molten synthetic resin. This has been impossible even in a surface fastener where hook and loop elements both made of fibers coexist as described above, and is realized by the present invention.

The surface fastener thus constructed is effectively manufactured by the following typical methods.

One typical manufacturing method is a continuous injection molding method in which a die wheel having in its circumferential surface a multiplicity of engaging-element-forming cavities is driven for one-way rotation and, at the same time, molten resin is continuously injected from a molten resin outlet of an injection die, which confronts the die wheel with a predetermined gap therebetween, to the circumferential surface of the die wheel by a predetermined width. Simultaneously, a coarse pile woven or knit cloth having piles on its one surface is continuously introduced into the gap between the die wheel and the molten resin outlet of the injection die. At that time, it is preferable to introduce the pile woven or knit cloth with the pile surface in contact with the circumferential surface of the die wheel. For this purpose, the circumferential surface of the die wheel has annular recesses spaced from the hook-element-forming cavities for receiving and guiding the pile surface.

The molten resin injected from the injection die toward the circumferential surface of the die wheel form the substrate sheet in the gap, and at the same time, part of the molten resin reaches the circumferential surface of the die wheel through the pores of the pile woven or knit cloth to embed the foundation structure of the pile woven or knit cloth in the molten resin injected from the injection die and to fill the hook-element-forming cavities to form hook elements. Then, while the circumferential surface of the die wheel is positively cooled by a cooling means to cool the molded surface fastener, the cooled molded surface fastener is continuously taken up from the circumferential surface of the die wheel.

Another typical manufacturing method is an extrusion molding method in which the die wheel having a multiplicity of engaging-element-forming cavities and annular recesses and a press roller confronting the die wheel with a predetermined gap are rotated synchronously in opposite directions. Simultaneously, molten resin is continuously extruded from an extrusion nozzle to the gap between the die wheel and the press roller by a predetermined width and, at the same time, the coarse pile woven or knit cloth is continuously introduced between the die wheel and the molten resin extruded from the extrusion nozzle. The molten resin forms the substrate sheet in the gap by the pressing force of the press roller and, at the same time, part of the molten resin reaches the circumferential surface of the die wheel through the pores of the pile woven or knit cloth to embed the pile woven or knit cloth in the molten resin and to fill the hook-element-forming cavities to form hook elements. Then, while the circumferential surface of the die wheel is positively cooled by the cooling means to cool the molded surface fastener, the cooled molded surface fastener is continuously taken up from the circumferential surface of the die wheel.

The pile woven or knit cloth whose foundation structure is at least partly embedded in the substrate sheet serves to assist in peeling the molded surface fastener off the die wheel. Namely, the substrate sheet formed on the circumferential surface of the die wheel is less extendible and is highly resistant against pull when the molded surface fastener is positively peeled off the circumferential surface of the die wheel after revolving along the rotation of the die wheel. Therefore, the pulling force acts effectively on the molded hook elements in the circumferential cavities of the die wheel so that the molded hook elements can be pulled out of the cavities without difficulty. Since the hook-element-side surface of the substrate sheet is hardly stretched, there occurs no difference in stretch between the front and back sides of the substrate sheet so that the surface fastener does not become curved in one direction after molding and the hook elements are distributed uniformly, thus causing a high-quality surface fastener which is uniform in engaging strength is obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary vertical cross-sectional view showing an apparatus for manufacturing a molded surface fastener according to a first embodiment of this invention;

FIG. 2 is a fragmentary, enlarged perspective view of a die wheel of the apparatus of FIG. 1;

FIG. 3 is a fragmentary perspective view of a pile core sheet to be used in the surface fastener manufactured according to the first embodiment;

FIGS. 4A through 4F are fragmentary cross-sectional views of various modifications of the surface fastener according to this invention;

FIG. 5 is a fragmentary vertical cross-sectional view of another apparatus for manufacturing a molded surface fastener according to a second embodiment of this invention;

FIG. 6 is a fragmentary perspective view of a modified pile core sheet;

FIG. 7 is a fragmentary perspective view of a typical surface fastener in which hook and loop elements exist mixedly;

FIG. 8 is a fragmentary perspective view similar to FIG. 7, showing a different pattern of arrangement of hook and loop elements; and

FIG. 9 is a side view showing the manner in which a pair of mating surface fasteners of this invention come into engagement with each other.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will now be described with reference to the accompanying drawings.

FIG. 1 is a fragmentary vertical cross-sectional view of a continuous injection molding apparatus for manufacturing a molded surface fastener according to a first embodiment of this invention.

In FIG. 1, reference numeral 1 designates an injection die; an upper half surface of the distal end of the injection die is an arcuate surface 1*a* substantially equal in curvature to a die wheel 2 described below, and a lower half surface is an arcuate surface 1*b* having such a curvature as to define a predetermined gap with respect to the curved surface of the die wheel 2. The injection die 1 is a T-shape die having a resin extrusion outlet 1*d* which is situated centrally of the upper and lower arcuate surfaces 1*a*, 1*b* and from which molten resin 4 is injected in a sheet form under a predetermined molten resin pressure. In this embodiment, the injection die 1 has a single molten resin runner 1*c* extending centrally.

The die wheel 2 has a circumferential surface partially adjacent to the upper arcuate surface 1*a* of the injection die 1 and is spaced from the lower arcuate surface 1*b* by the predetermined gap, with its axis parallel to the extrusion outlet 1*d* of the injection die 1. According to the illustrated embodiment, a number of hook-element-forming cavity sets 5 are arranged on the circumferential surface of the die wheel 2, adjacent cavity sets being spaced by a predetermined distance in a direction parallel to the axis of the die wheel 2 to define therebetween an annular recess 16. The basic structure of the die wheel 2 is substantially identical with the structure disclosed in U.S. Pat. No. 4,775,310 with slight modification and is hence described here only briefly. The die wheel 2 is in the form of a hollow drum having a water cooling jacket 2*a*, and in each cavity set portion, a number of die rings and a number of spacer rings are laminated alternately along the axis of the hollow drum as shown in FIG. 2. Each of the die rings has on circumferential edges a multiplicity of hook-element-forming cavities 5*a* with their bases opening to the circumferential surface of the die ring. Each of the spacer rings has on each of front and back sides a flat surface. Each annular recess 16 is composed of a number of laminated rings, having a predetermined outer diameter smaller than the outer diameter of the die rings of each cavity set 5. The die wheel 2 is driven, by a non-illustrated known synchronous drive unit, to rotate in a direction indicated by an arrow.

A pile woven or knit core sheet (hereinafter called "the pile core sheet") S drawn from a roll is introduced to the gap between the upper arcuate surface 1*a* of the injection due 1 and the circumferential surface of the die wheel 2 via a tension adjuster 3 after contacting part of the circumferential surface of the die wheel 2. In this illustrated embodiment, a cooling water tank 10 is situated under the die wheel 2 with a lower portion of the die wheel 2 being soaked in the cooling water tank 10. A guide roller 9 is situated diagonally upwardly of the cooling water tank 10, and a set of upper and lower take-up rollers 6, 7 rotating at a speed slightly higher than the rotating speed of the die wheel 2 is situated in front of the guide roller 9.

The pile core sheet S to be used in this embodiment has a number of pile regions S1 of a predetermined width and a number of coarse mesh regions S2 of a predetermined width arranged alternately in the transverse direction as shown in FIG. 3. The foundation structure of each pile region S1 is woven or knitted of fiber at a high density so as not to allow molten resin 4 to pass through, and the coarse mesh region S2 is devoid of piles and is woven or knitted of fiber so as to have pores for the passage of molten resin 4. Further, in this embodiment, a pile surface of the pile regions S1 of the pile core sheet S is treated with a napping process. Therefore, the pile surface acquires greater flexibility, and the multifilament piles consisting loop elements 15 have various loop directions so that the engaging rate with mating hook elements 4*b* increases.

The fiber material is thermoplastic resin as exemplified by nylon, polyester and polypropylene or metal wire. Although the thermoplastic synthetic resin for the surface fastener and the fiber material are preferably the same, they may be different. The size of the fibers, fiber yarns or metal wires of the pile core sheet S is determined by the required thickness of the pile core sheet S. Further, the thickness of the pile core sheet S, which is determined depending on the thickness of the substrate sheet 4*a* of the surface fastener, is usually preferably 20–60% of the thickness of the substrate sheet 4*a*. In compliance with the resin material to be used, the molten resin temperature, molten resin pressure, die wheel temperature and rotational speed of the die wheel are adjusted as a matter of course. The required molten resin pressure is usually in the range of 50–150 kg/cm^2, preferably 80–110 kg/cm^2.

In this embodiment, the height of the hook elements 4*b* is greater than that of the loop elements 15 unlike the surface fastener disclosed in U.S. Pat. No. 5,231,738 in which the hook elements are shorter than the loop elements. In the prior surface fastener, the hook elements are formed by cutting part of monofilament loops that are formed simultaneously with the weaving or knitting of the surface fastener, so that the cut remainings projecting from the foundation structure and possible burrs formed when cutting would give an uncomfortable touch during the engaging. In order to give a comfortable touch, in the prior surface fastener, the loop elements are higher than the hook ele-

ments. In the surface fastener of this invention, since the hook elements *4b* are molded of synthetic resin and not formed of monofilaments, the individual hook element *4b* has at its top a smoothly curved surface with no rough touch and is highly stable in shape, so that hook elements are easy to engage the loop elements **15** in spite of the short loop elements **15** as shown in FIG. **9** and the gap between the mating substrate sheets **3** can be reduced to a minimum during engaging.

For molding the surface fastener of this invention on the apparatus, the molten resin **4** to be continuously injected from the injection die **1** at a predetermined molten resin pressure is continuously forced into the gap between the injection die **1** and the rotating die wheel **2**. At the same time, the pile core sheet S is guided with the piles being received in the annular recesses **16** of the die wheel **2**, and part of the molten resin **4** penetrates into the foundation structure of the pile regions S1 at the injection-outlet side, while part of the molten resin **4** is extruded onto the circumferential surface of the die wheel **2** through the pores of the coarse mesh regions S2, filling in the hook-element-forming cavities *5a* successively to form hook elements *4b* as the molten resin **4** is expanded uniformly over the circumferential surface of the die wheel **2**. As a result, the molten resin **4** remaining on the injection outlet of the injection die **1** and the expanded molten resin **4** are fused with the component material of the pile core sheet S to form the substrate sheet *4a* having a predetermined thickness.

During this molding, the pile core sheet S keeps traveling around the circumferential surface of the die wheel **2** as it is forced thereagainst under molten resin pressure. Therefore, in the manufacturing method of this embodiment, it is unnecessary to intentionally force the pile core sheet S against the circumferential surface of the die wheel **2** while introducing; namely, as it is introduced into the above-mentioned gap merely with a just slack-free tension, the pile core sheet S is necessarily forced against the circumferential surface of the die wheel **2** so that the pile core sheet S is embedded in the substrate sheet *4a* of the molded surface fastener eccentrically toward the hook-element-surface side or front-surface side as shown in FIG. **2**.

The molten resin **4** shaped into the surface fastener on the circumferential surface of the die wheel **2** travels around substantially a half of the circumferential surface of the die wheel **2** as guided by the guide roller **9**. During that time, the molten resin **4** is cooled from the inside of the die wheel **2** and is further cooled while passing through the cooling water tank **10** so that the substrate sheet *4a*, in which the pile core sheet S is embedded, integrally with the hook elements *4b* become gradually hard. When the substrate sheet *4a* is positively taken up horizontally by the take-up rollers **6**, **7** durinng this hardening, since the pile core sheet S is embedded in the substrate sheet *4a* eccentrically toward the hook-element-surface side, the pile-core-sheet-embedded-side surface of the substrate sheet *4a* does not extend even if it is pulled away from the circumferential surface of the die wheel **2**, so that the front and back surfaces of the substrate sheet *4a* have no difference of extension, thereby making the surface fastener free from curving in one direction after being removed from the die wheel **2**. Accordingly, the uniform engaging strength and a uniform density of hook elements can be achieved over the entire surface of the surface fastener, and the individual hook elements *4b* can be pulled out of the cavities *5a* smoothly as they resiliently deform. Immediately after being removed off the die wheel **2**, the hook elements *4b* restore their original shape to become hard completely and, the surface fastener on which the multifilaments consisting the loop elements **15** face various directions, as shown in FIG. **4F**. In this instance, if the napping process is not treated to the pile core sheet S beforehand, all filaments of the multifilament loop elements **15** face almost the same direction, as shown in FIG. **4B**.

In this embodiment, in order to peel the molded resin product (i.e., the surface fastener with the pile core sheet embedded in the substrate sheet) off the die wheel **2**, the upper and lower take-up rollers **6**, **7** synchronously rotating in opposite directions are used. The circumferential surfaces of these take-up rollers **6**, **7** may be smooth but preferably have circumferential grooves for receiving the hook elements *4b* so as not to damage them. The rotational speed of the take-up rollers **6**, **7** is slightly higher than that of the die wheel **2** in such a manner that the hook elements *4b* can be removed smoothly off the hook-element-forming cavities *5a*.

In the thus manufactured surface fastener, since the pile core sheet S is embedded in the substrate sheet *4a* eccentrically toward the hook-element-surface side, it is possible to give the substrate sheet *4a* adequate toughness both longitudinally and transversely so that products of uniform quality can be obtained as mentioned above. In the resulting surface fastener, no stretch occurs during cutting under tension, and no breakage of a sewing needle occurs during sewing.

FIG. **5** is a vertical cross-sectional view of an apparatus for manufacturing a surface fastener according to a second embodiment of this invention by extrusion molding.

In the second embodiment, an extrusion nozzle **11** is used to substitute for the injection die **1**, and a press roller **13** is situated under the die wheel **2** with a predetermined gap. A molten resin extrusion outlet *11a* of the extrusion nozzle **11** is situated to face the gap between the die wheel **2** and the press roller **13**. In this embodiment, the most important point is that the pile core sheet S is introduced into the gap between the circumferential surface of the die wheel **2** and the molten resin **4**, which is extruded from the molten resin extrusion outlet *11a* of the extrusion nozzle **11**, via the tension adjusting section **3**, after partially contacting the circumferential surface of the die wheel **2**. Further, a cooling water jacket *2a* for cooling the circumferential surface of the die wheel **2** from the inside is situated in the die wheel **2**, and a cooling air blower **14** is situated for blowing cooling air to the circumferential surface of the die wheel **2** having passed the pressing surface of the press roller **13**. The die wheel **2** and the press roller **13** are driven, by a non-illustrated drive unit, to synchronously rotate in opposite directions as indicated by arrows in FIG. **5**.

A guide roller **9** is situated diagonally upwardly of the cooling air blower **14**, and a set of upper and lower take-up rollers **6**, **7** rotating at a speed slightly higher than that of the die wheel **2** are situated in front of the guide roller **9**.

According to the thus constructed apparatus, the molten resin **4** extruded from the extrusion nozzle **11** is introduced to the gap between the press roller **13** and the pile core sheet S, which is introduced along the circumferential surface of the die wheel **2**, to be forced through the pores of the pile core sheet S to the circumferential surface of the die wheel **2** by the pressing force of the pressing roller **13**. The pile core sheet S is guided with the piles being received in the annular recesses **16** of the die wheel **2**, and at the same time, part of the molten resin **4** penetrates into the foundation structure of the pile regions S1 at the extrusion-outlet side while part of the molten resin **4** is extruded onto the circumferential surface of the die wheel **2** through the pores

of the coarse mesh regions S2, filling in the hook-element-forming cavities 5a successively to form hook elements 4b as the molten resin 4 is expanded uniformly over the circumferential surface of the die wheel 2. The thus molded surface fastener of this invention travels along substantially a quarter of the die wheel 2 and is then continuously removed off the circumferential surface of the die wheel 2 as positively take up by the take-up rollers 6, 7 via the guide roller 9.

Meanwhile, the molded surface fastener is gradually cooled by a cooler 2a in the die wheel 2 and is further cooled by air blown from the cooling air blower 14, thus becoming hard. In this embodiment, if the pile core sheet S to be introduced to the gap between die wheel 2 and the press roller 13 is previously heated to eliminate any difference in temperature from the semimolten high-temperature substrate sheet 4a, their fusion will be more reliable.

FIG. 6 shows a modified pile core sheet S, in which a number of pile regions S1 and a number of coarse mesh regions S2 are arranged alternately in the longitudinal direction of the pile core sheet S. When this modified pile core sheet S is to be used, the circumferential surface structure of the die wheel 2 is required to be changed to meet the construction of the pile core sheet S. Namely, a number of hook-element-forming cavity sets 5 and a number of pile-receiving recesses 16 are arranged alternately in the circumferential direction of the die wheel. The cross-sectional view of the surface fastener to be molded in this case is shown in FIG. 4E.

FIG. 7 shows a surface fastener in which the hook elements 4b and the loop elements 15 are alternately arranged in the direction either longitudinal or transverse of the substrate sheet 4a. FIG. 8 shows a surface fastener in which the rows of hook elements 4b and the loop elements 15 are alternately arranged in the longitudinal direction of the substrate sheet 4a. For manufacturing the surface fasteners of these shapes shown in FIGS. 7 and 8, each pile core sheet S must have a coarse foundation structure having adequate pores enough to allow molten resin 4 to pass through, and the piles must be formed in a predetermined arrangement and at predetermined intervals.

On the other hand, the die wheel 2 has a number of pile-receiving recesses 16 in the circumferential surface at positions corresponding to the piles and a multiplicity of hook-element-forming cavities 5a between adjacent recesses 16. The distance of the recesses 16 and the hook-element-forming cavities 5a are determined according to the pile distance of the pile core sheet S.

FIGS. 4A through 4E shows various modified surface fasteners in which the hook elements 4b and the loop elements 15 coexist on the same substrate sheet. FIG. 4B schematically shows a cross-sectional structure of the surface fastener manufactured by the apparatus of FIGS. 1 and 5. FIG. 4D schematically show a cross-sectional view of the surface fastener shown in FIG. 7. For manufacturing the surface fastener having a cross-sectional structure of FIG. 4A, the pile core sheet S of FIG. 3 is used, and in the case of continuous injection molding, the injection die 1 has a number of injection outlets 1d transversely spaced at regular distances to meet the hook-element-forming cavity sets 5, and alternatively in the case of extrusion molding, a number of circumferentially extending annular lands are arranged at predetermined spaces in a direction parallel to the axis of the press roller to meet the respective sets of loop elements 15. For manufacturing the surface fastener having a cross-sectional structure of FIG. 4C, the pile core sheet S has a small width, and the pile region S1 is located centrally in the direction transverse of the pile core sheet S while a pair of transversely spaced coarse mesh regions S1 are located at opposite sides of the pile region S1, and other manufacturing conditions are the same as those for the surface fastener of FIG. 4A.

In the foregoing embodiments, the hook elements and the loop elements are formed on the same surface of the substrate sheet. Alternatively, the hook elements may be formed on the front surface of the substrate sheet and the loop elements may be formed on the back surface of the substrate sheet, in such a manner that sets of hook elements and sets of loop elements do not project on the same portion of the substrate sheet so as to be arranged alternately with respect to one another. In this alternative case, the pile surface of the pile core sheet is introduced to the molten resin surface opposite to the die wheel. At that time, as a matter of course, the pile regions and the coarse mesh regions are arranged alternately in the pile core sheet, and the hook-element-forming cavity sets and the smooth surfaces are alternately arranged on the circumferential surface of the die wheel at predetermined spaces in the direction circumferential of the die wheel.

In the foregoing embodiments, the individual hook element 4b has a reinforcing rib 4c on each of opposite side surfaces. The individual hook elements 4b are oriented in a common direction in the same row and are oriented in opposite direction in adjacent rows. The reinforcing ribs 4c, which may be omitted, are effective in preventing the hook elements 4b from falling sideways. In this invention, adjacent hook elements 4b in the same row may be oriented alternately in opposite directions. With this arrangement, a surface fastener which does not have direction in engaging force can be obtained. This invention should by no means be limited to the foregoing embodiments and various modifications may be suggested without departing from the concept of this invention.

As is apparent from the foregoing detailed description, according to this invention, it is possible to continuously manufacture a molded surface fastener in which at least part of foundation structure of the pile core sheet is embedded in the substrate sheet in a single molding step rather than in a plurality of meticulous molding steps, and the obtained surface can secure adequate toughness in the longitudinal and transverse directions at the same time. Further, during the molding, there is no extension difference between the front and back surfaces of the substrate sheet when the surface fastener is peeled off the circumferential surface of the die wheel, and therefore the density of hook elements would be uniform over the entire area so that high-quality products excellent in size precision and having a uniform engaging strength can be achieved.

Further, since the pile core sheet is manufactured by weaving or knitting, it is possible to change the design of the pile core sheet in arrangement and orientation of piles and to determine the size, shape or arrangement of hook elements optionally. It is accordingly possible to cope instantly with various requirements for the surface fastener in which hook and loop elements coexist.

Particularly in this invention, the pile core sheet S is manufactured in a process different from this molding process of the surface fastener and the pile surface of the pile core sheet S is not influences by the molding resin, so that it is possible to treat the pile surface with the napping process prior to the molding of the surface fastener, thus the engaging rate of the product improves. Further, in the case

that the height of the hook elements is greater than that of the loop elements, since the hook elements are molded of synthetic resin and not formed of monofilaments so that the individual hook element has at its top a smoothly curved surface with no rough touch and is highly stable in shape, hook elements are easy to engage the loop elements in spite of the short loop elements and the gap between the mating substrate sheets can be reduced to a minimum during engaging.

What is claimed is:

1. A surface fastener molded of synthetic resin, comprising:

(a) a plate-like substrate sheet;

(b) a multiplicity of hook elements; and

(c) a multiplicity of loop elements;

(d) said hook elements being molded of a synthetic resin material integrally with said plate-like substrate sheet on one surface of said plate-like substrate sheet, and said loop elements being composed of piles projecting from a pile woven or knit cloth;

(e) at least part of a foundation structure of said pile woven or knit cloth being embedded into said substrate sheet simultaneously with the molding of said substrate sheet said hook elements and said loop elements projecting on one side of said surface fastener.

2. A molded surface fastener according to claim 1, wherein said hook elements have a height greater than that of said loop elements.

3. A molded surface fastener according to claim 1, wherein said loop elements are treated with a napping process.

4. A molded surface fastener according to claim 1, wherein said foundation structure of said pile woven or knit cloth is a coarse woven or knit structure having pores large enough to pass molten resin material throughout its entire area, and said hook and loop elements exist mixedly on said one surface of said substrate sheet.

5. A molded surface fastener according to claim 1, wherein said foundation structure of said pile woven or knit cloth is high in density at its pile areas and has a coarse woven or knit structure at the remaining areas coarse enough to pass molten resin material.

6. A molded surface fastener according to claim 1, wherein said hook elements and said loop elements are arranged alternately in parallel predetermined regions on said one surface of said substrate sheet.

* * * * *

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Shepard et al.

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(45) **Date of Patent: Mar. 27, 2001**

(54) **COMPOSITE HOOK AND LOOP FASTENERS, AND PRODUCTS CONTAINING THEM**

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(22) Filed: **Nov. 6, 1998**

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(52) **U.S. Cl.** ..... **24/30.5 R**; 24/304; 24/306; 24/450
(58) **Field of Search** ..... 24/30.5 R, 30.5 P, 24/306, 450, 304, 452, 442, 693; 128/DIG. 15; 428/100; 383/71, 75

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,000,384	9/1961	Piers, Jr.	132/46
3,322,325	5/1967	Bush	229/62
4,074,397 *	2/1978	Rosin	24/304 X
4,088,136	5/1978	Hasslinger et al.	128/349 R
4,097,634	6/1978	Bergh	428/156
4,149,540	4/1979	Hasslinger	128/327
4,247,967	2/1981	Swinton	24/143 R
4,465,486 *	8/1984	Hill	24/30.5 R
4,569,348	2/1986	Hasslinger	604/179
4,672,722	6/1987	Malamed	24/446
4,706,914 *	11/1987	Ground	24/306 X
4,761,318	8/1988	Ott et al.	428/85
4,794,028	12/1988	Fischer	428/100
4,815,172	3/1989	Ward	24/16 R
4,854,735	8/1989	Rutledge	383/72
4,906,108	3/1990	Herrington et al.	383/71
4,913,560	4/1990	Herrington	383/71
4,933,224	6/1990	Hatch	428/100
4,939,818	7/1990	Hahn	24/16 R
4,955,981	9/1990	Provost	383/86
4,986,265	1/1991	Caponi	128/82
4,999,067 *	3/1991	Erb et al.	428/100 X
5,048,158	9/1991	Koerner	24/16 R
5,142,743	9/1992	Hahn	26/16 R
5,168,603	12/1992	Reed	24/16 R
5,172,980	12/1992	Provost	383/204
5,200,245	4/1993	Brodrick, Jr.	428/100
5,231,738	8/1993	Higashinaka	24/446
5,260,015	11/1993	Kennedy et al.	264/167
5,286,111	2/1994	Brembilla	383/62
5,293,884	3/1994	Chapman et al.	132/200

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

10-137008 * 5/1998 (JP).

OTHER PUBLICATIONS

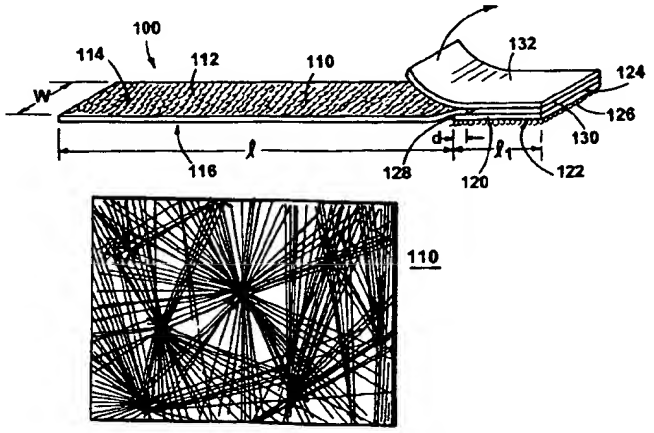
Velcro Brand Fastening Systems, Sewing Guide, company publication, Velcro USA, Inc., 1989.

Primary Examiner—James R. Brittain
(74) *Attorney, Agent, or Firm*—Fish & Richardson P.C.

(57) **ABSTRACT**

A composite hook and loop fastener in the form of an elongated strip has an elongated loop component, a hook component permanently affixed to the loop component, and a backing layer disposed on a face of the wrap tie in a discrete region. The backing layer is used for permanent attachment of the wrap tie to a supporting surface. One end of the loop component is available for encircling an object to be wrapped and engaging the fastener elements of the hook component. The loop component has a self-supporting web of entangled fibers, the fibers forming both a sheet-form body and hook-engageable, free-standing loops extending from at least one surface of the body, and the hook component has fastener elements extending from a common base. The backing layer may be a pressure sensitive adhesive or a synthetic resin.

25 Claims, 14 Drawing Sheets



U.S. PATENT DOCUMENTS

5,321,855		6/1994	Ciuffo 2/239
5,403,413		4/1995	Masuda 156/66
5,441,687		8/1995	Murasaki et al. 264/167
5,452,877		9/1995	Riffle et al. 248/511
5,518,795		5/1996	Kennedy et al. 428/100
5,595,014		1/1997	Moore 43/25
5,604,961		2/1997	Cole 24/306
5,606,781		3/1997	Provost et al. 24/452
5,614,057	*	3/1997	Conley, Jr. et al. .
5,620,769		4/1997	Wessels et al. 428/100
5,624,429		4/1997	Long et al. 604/391
5,636,414	*	6/1997	Litchholt 24/304
5,643,651	*	7/1997	Murasaki ..... 24/442 X
5,669,120		9/1997	Wessels et al. 24/446
5,672,404		9/1997	Callahan, Jr. et al. 428/100
5,786,062		7/1998	Callahan, Jr. et al. 428/100
5,868,407	*	7/1999	Kato et al. .

* cited by examiner

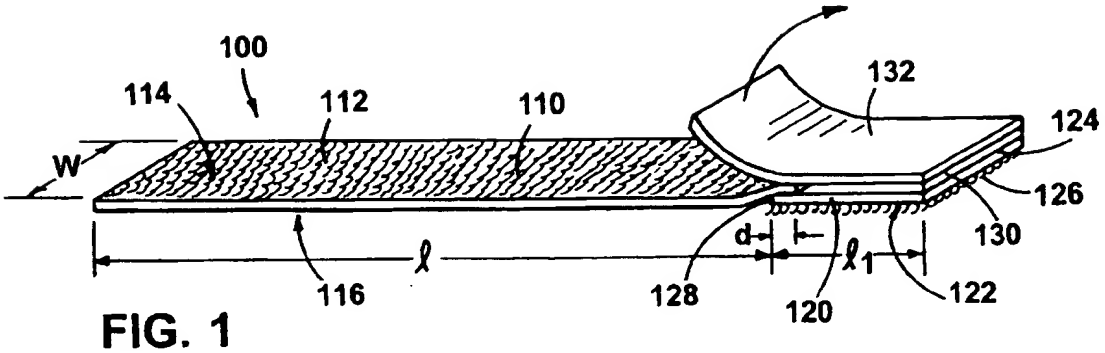


FIG. 1

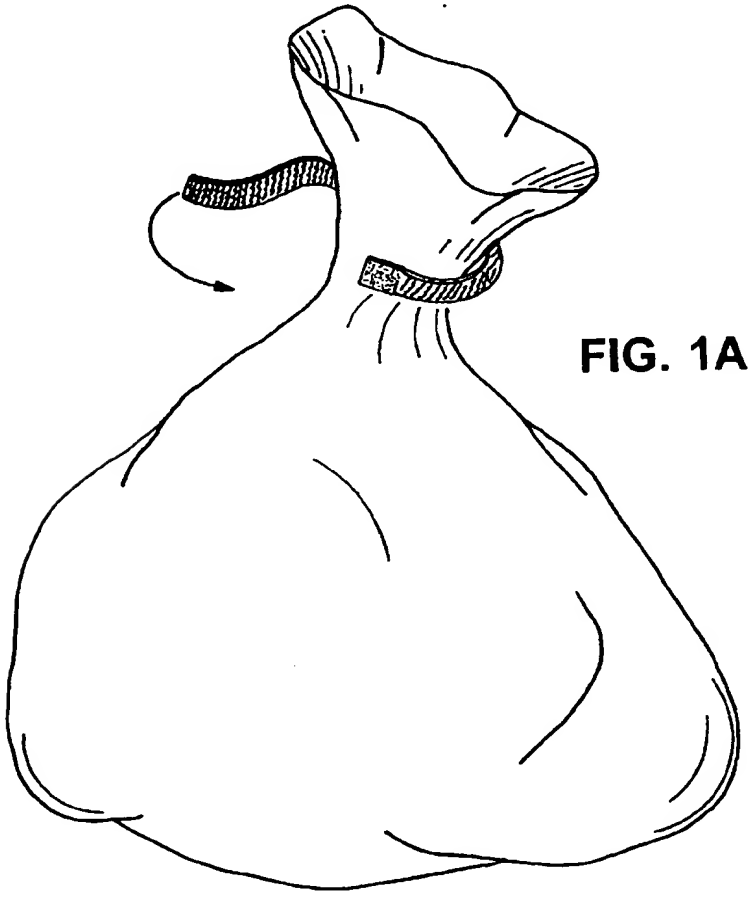


FIG. 1A

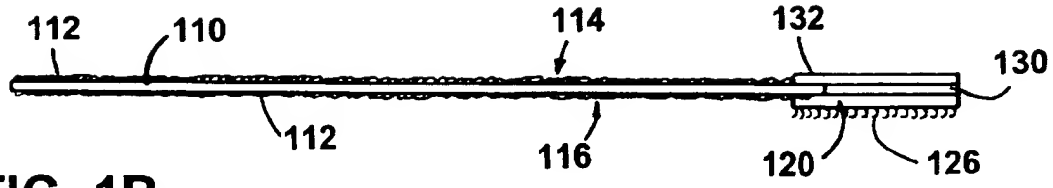


FIG. 1B

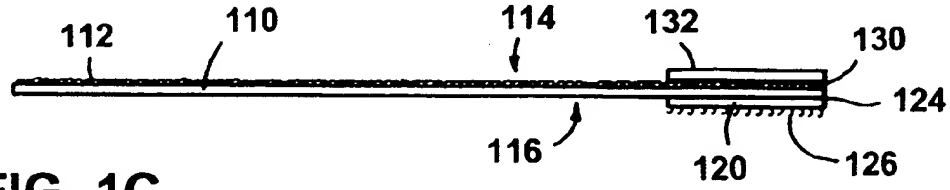


FIG. 1C

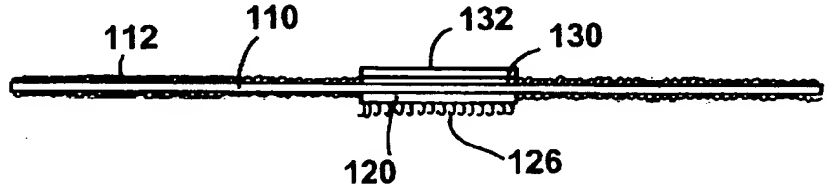


FIG. 1D

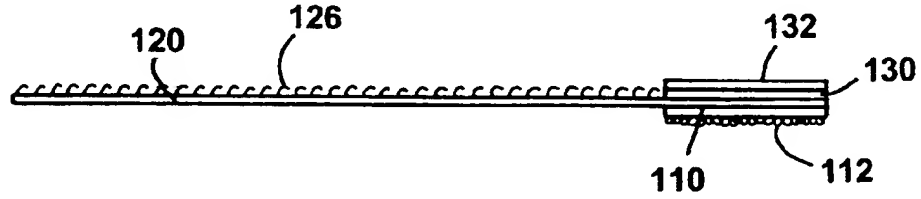


FIG. 1E

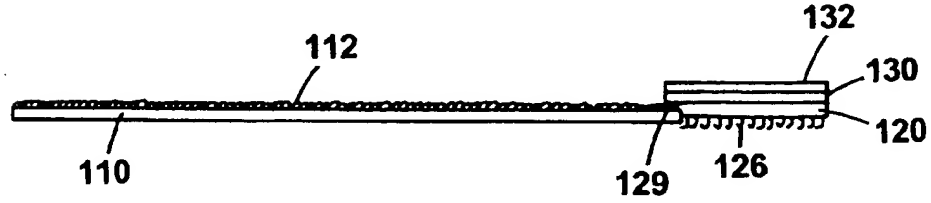


FIG. 1F

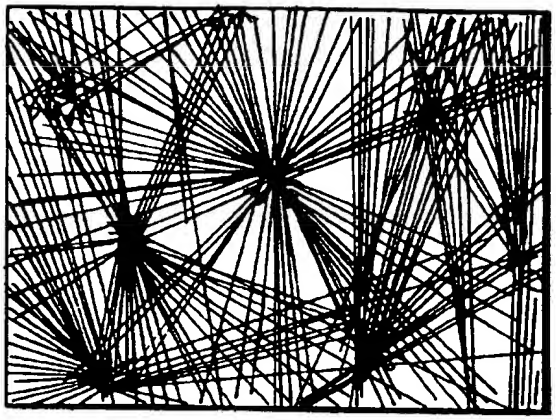


FIG. 2A

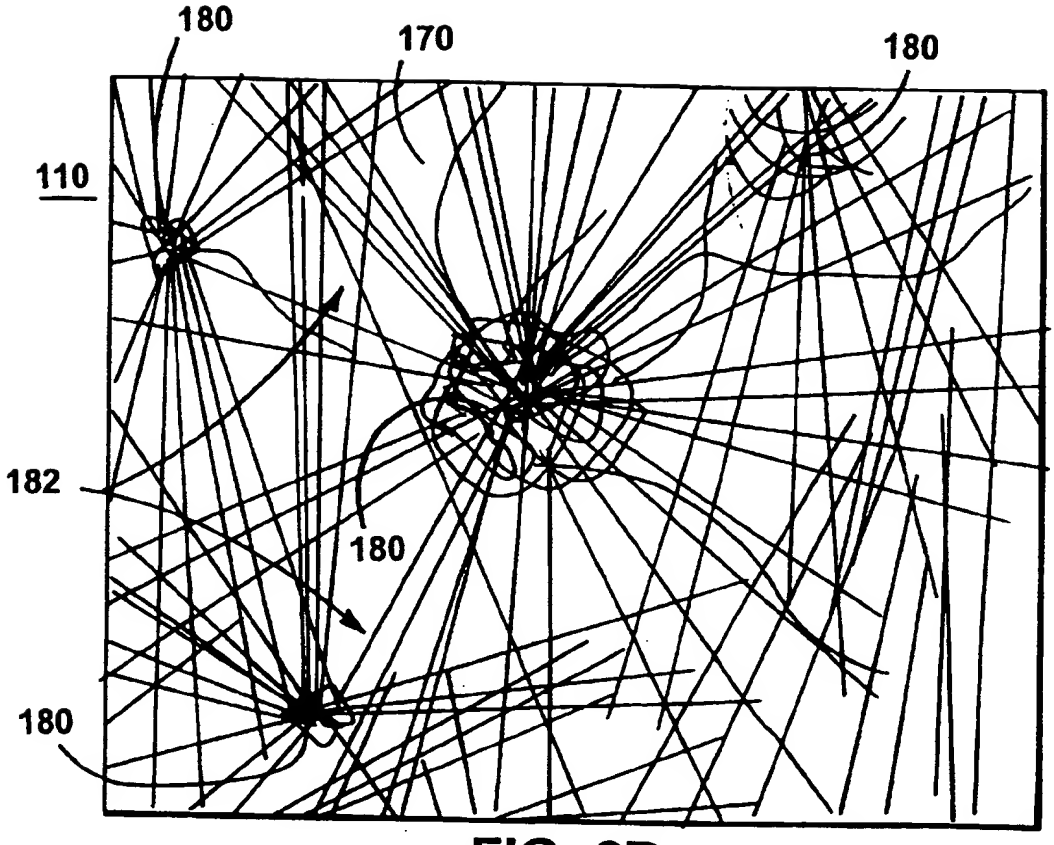


FIG. 2B

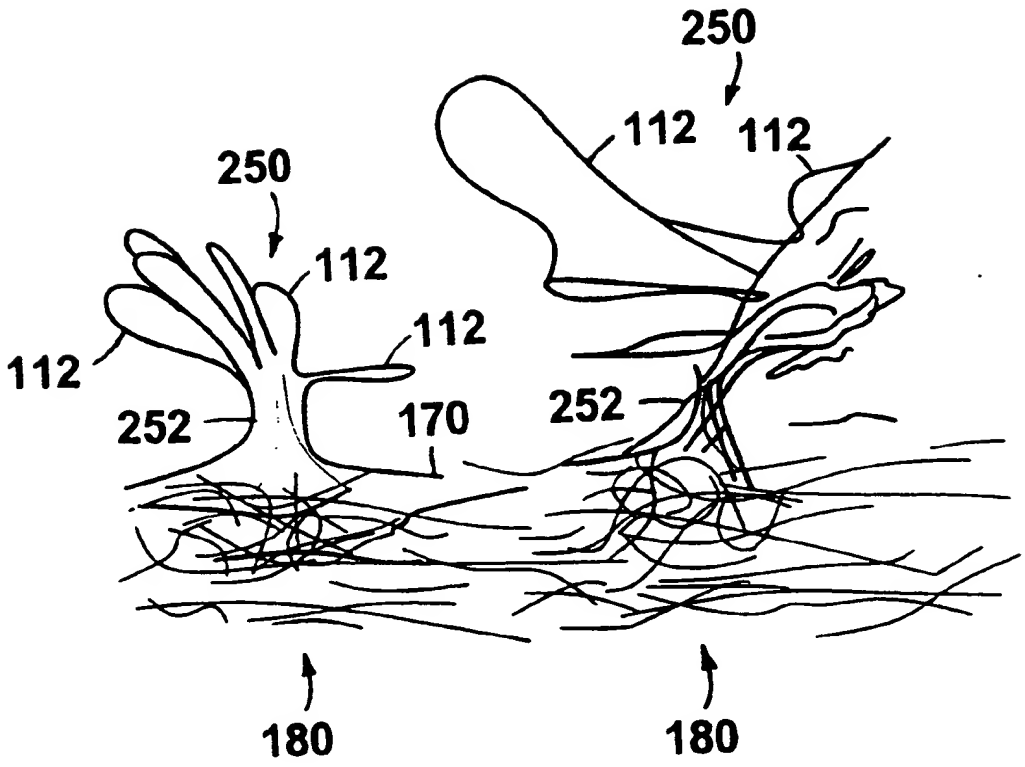


FIG. 2C

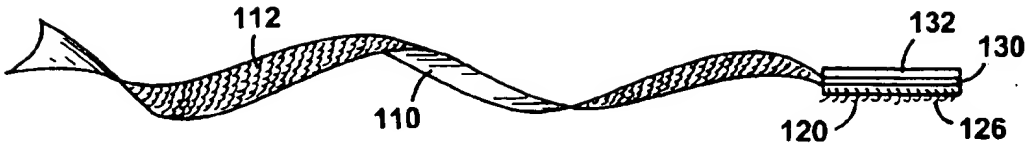


FIG. 3

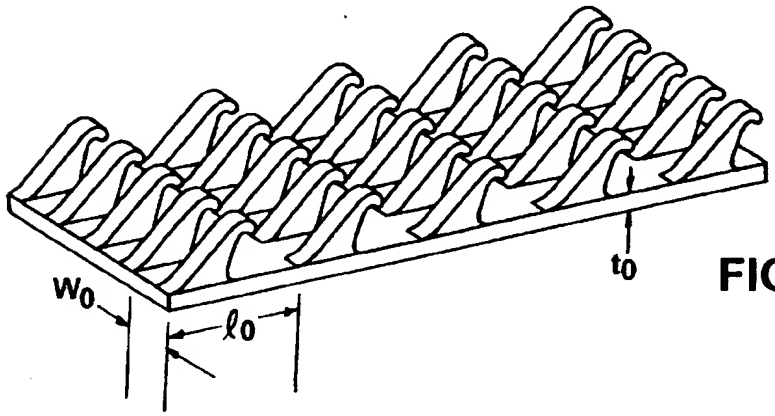


FIG. 4A

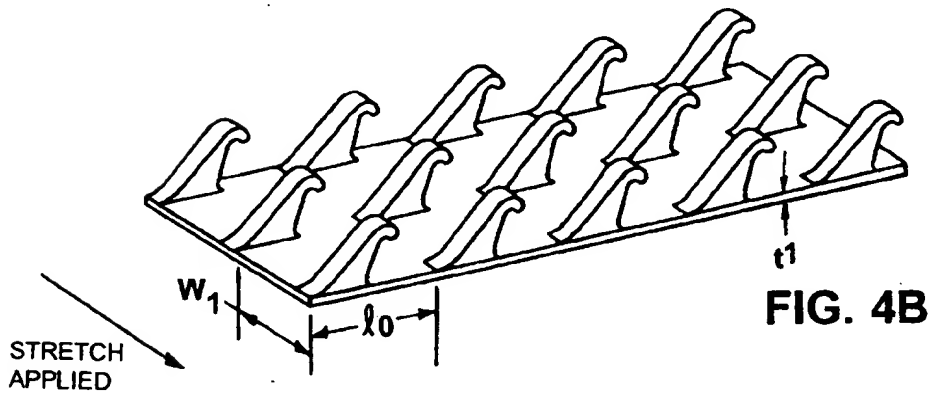


FIG. 4B

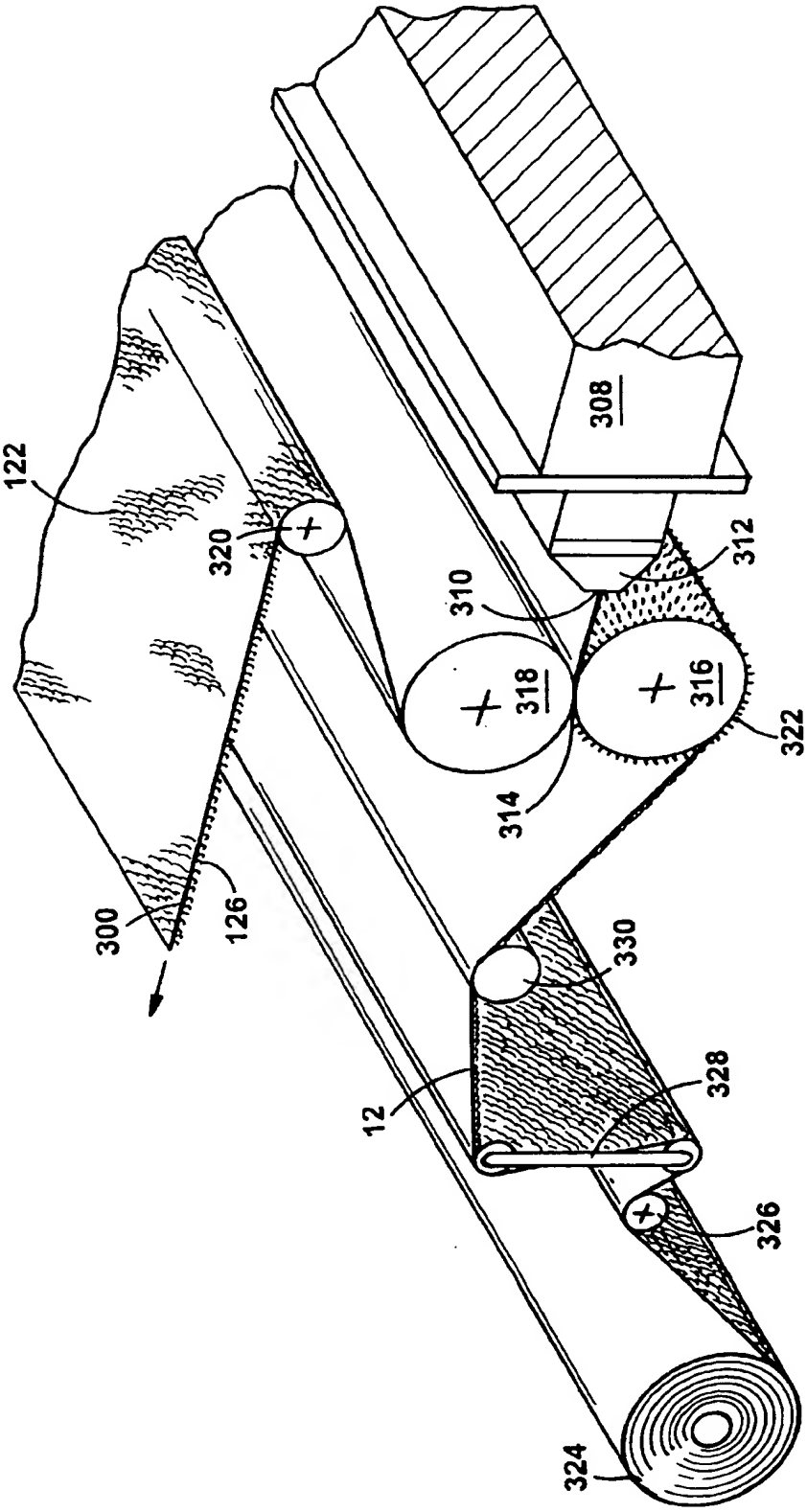
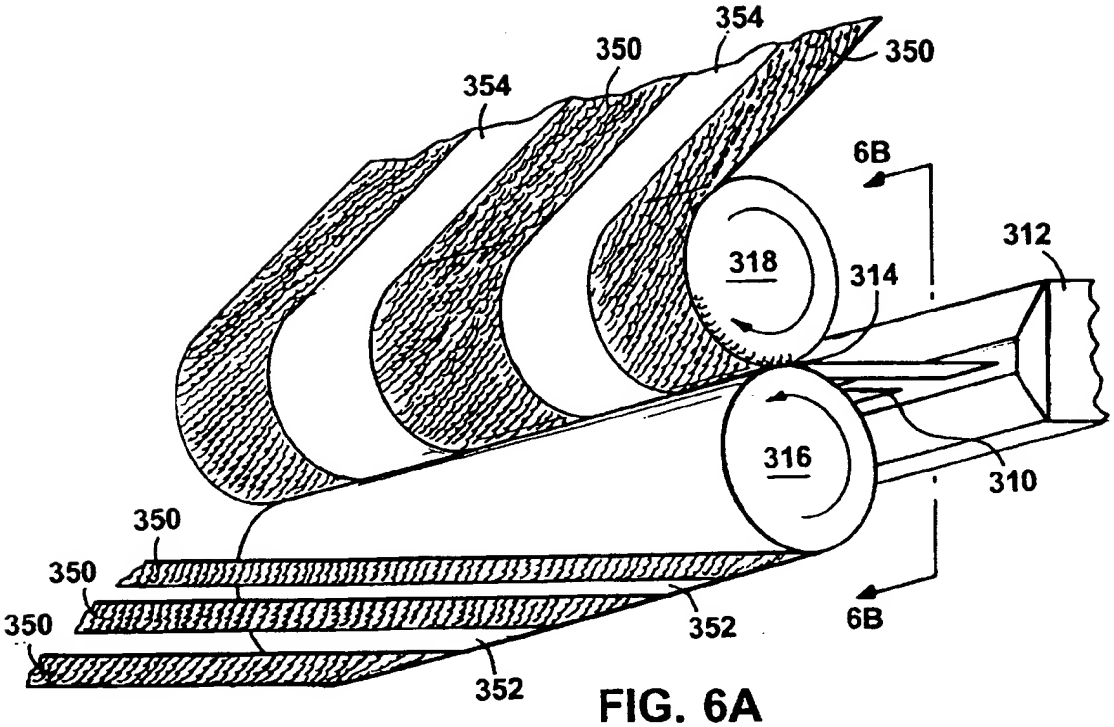


FIG. 5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6B
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310
350
350
350
352
352
6B

FIG. 6A

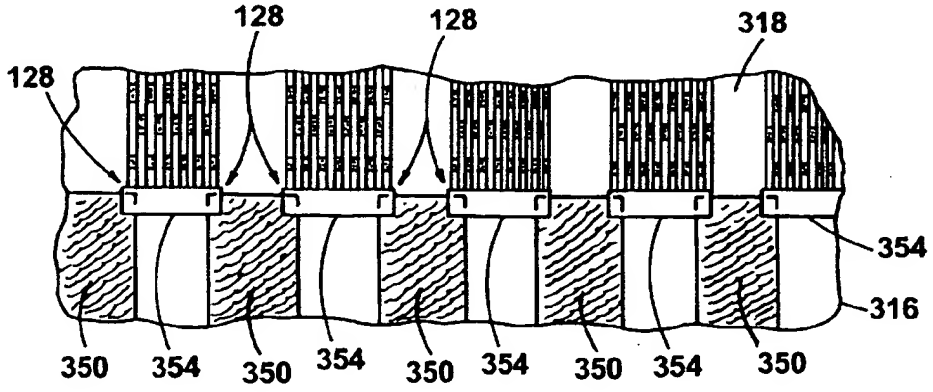
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FIG. 6B

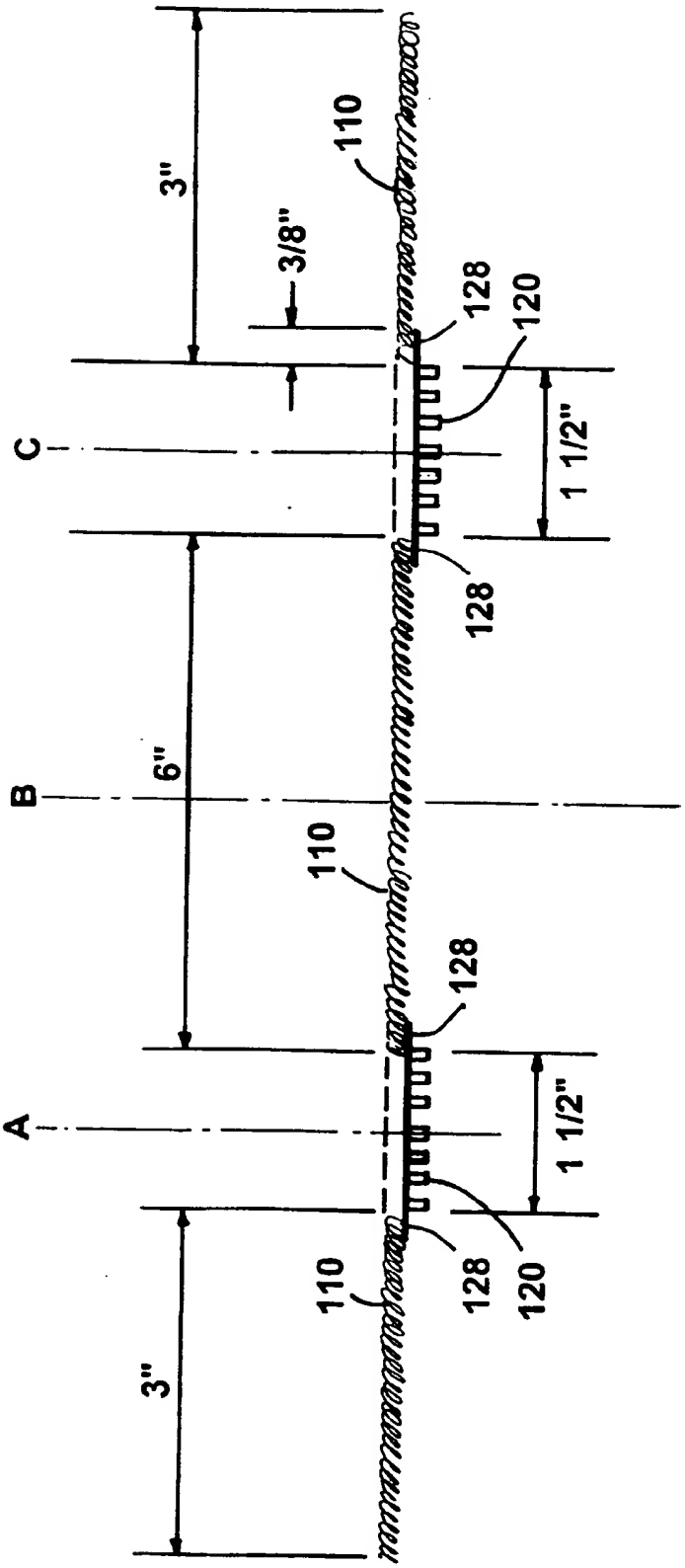


FIG. 7

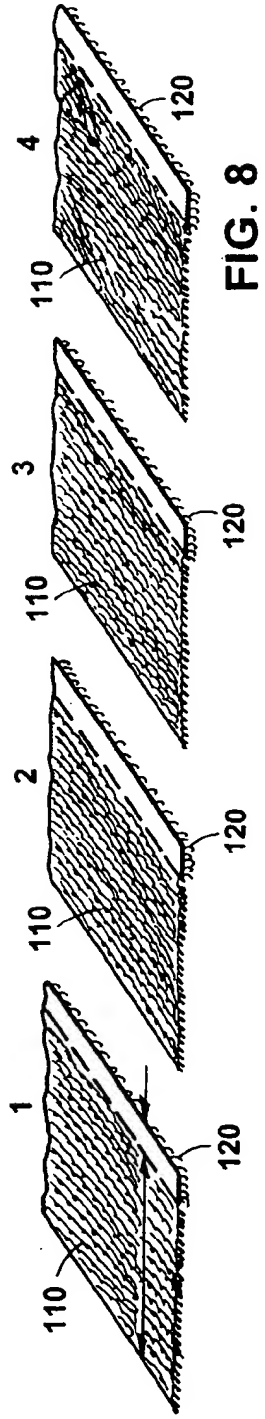


FIG. 8

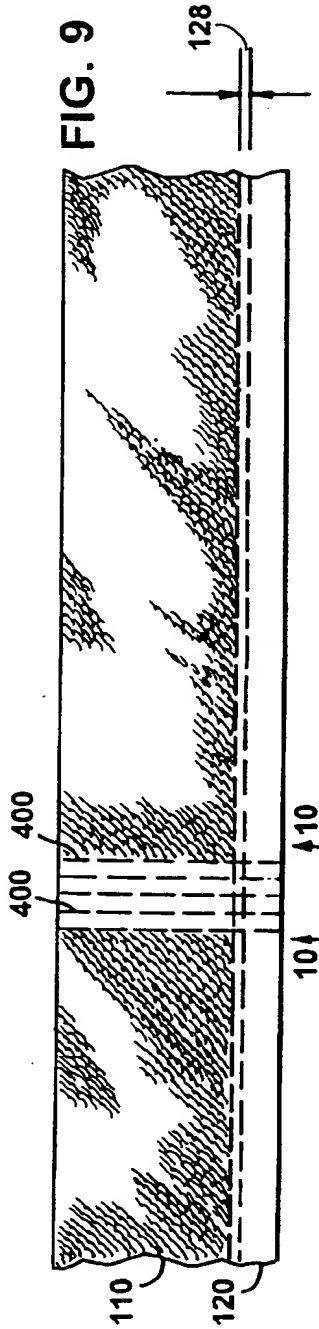


FIG. 9

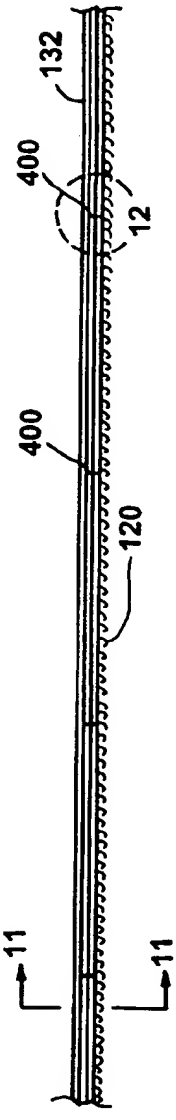


FIG. 10

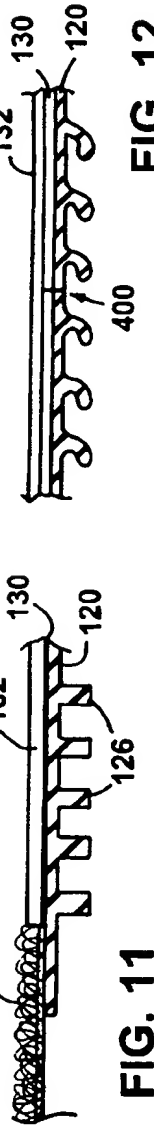


FIG. 11

FIG. 12

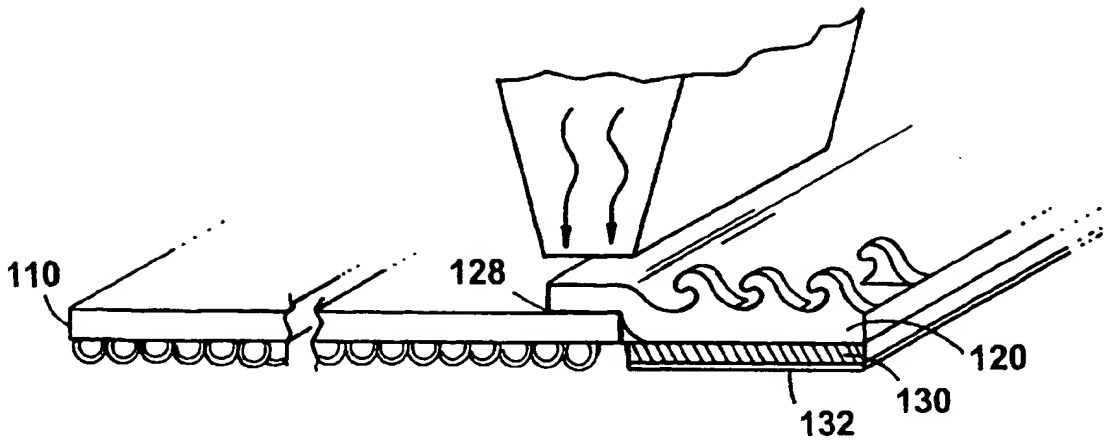


FIG. 13

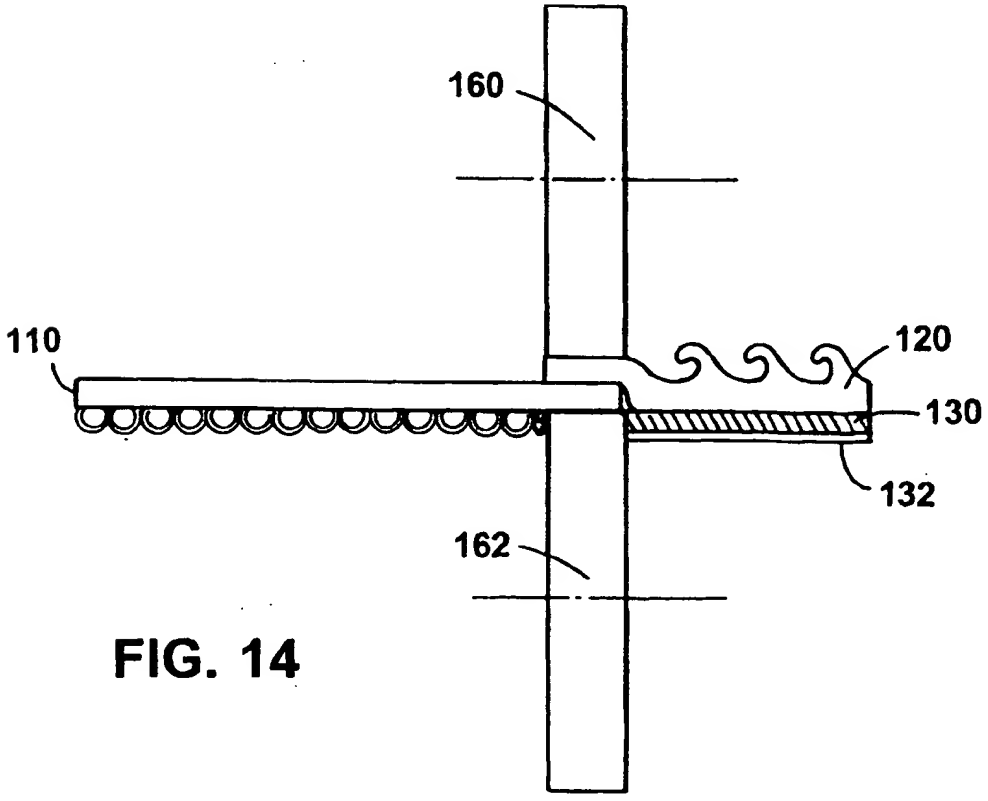


FIG. 14

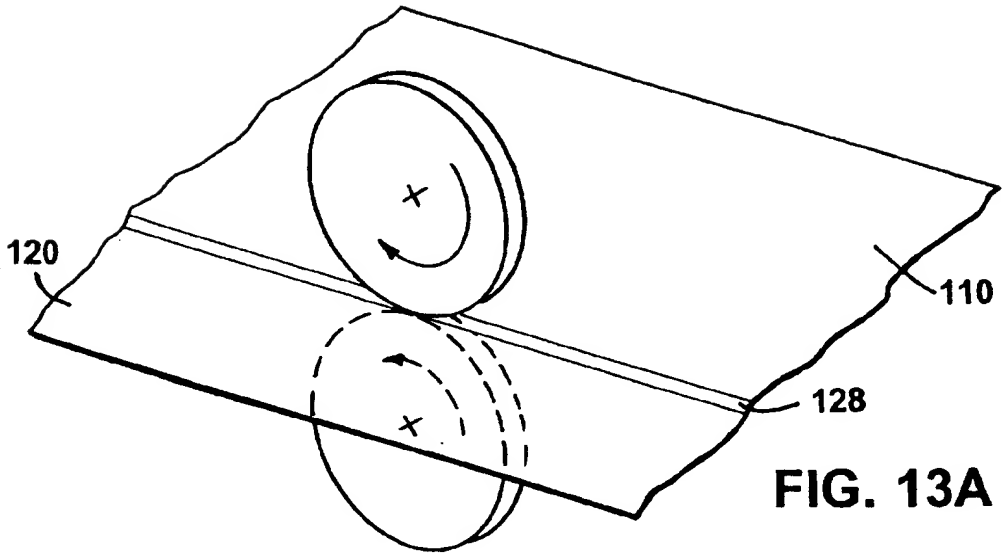


FIG. 13A

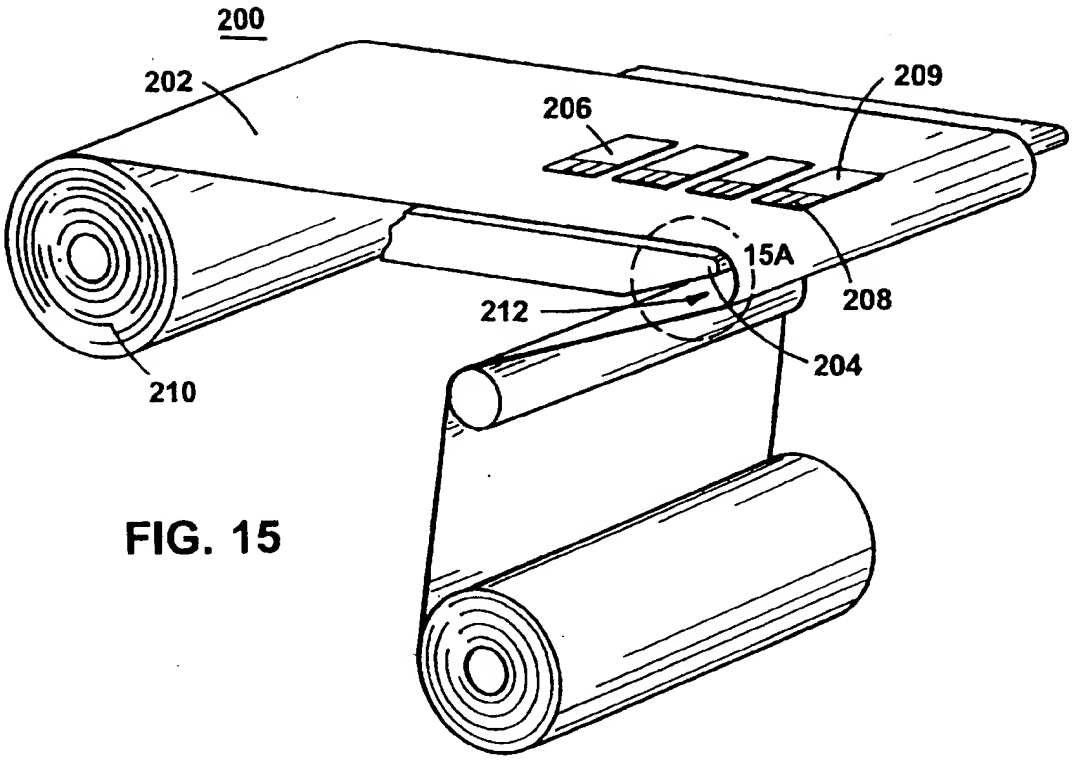


FIG. 15

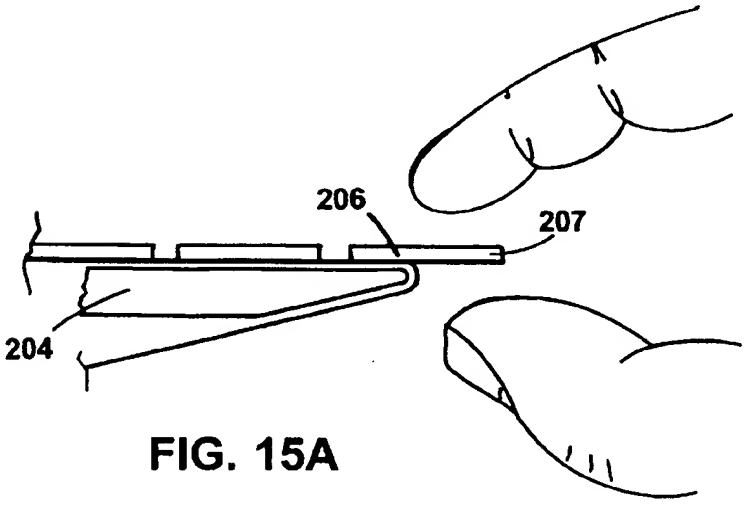


FIG. 15A

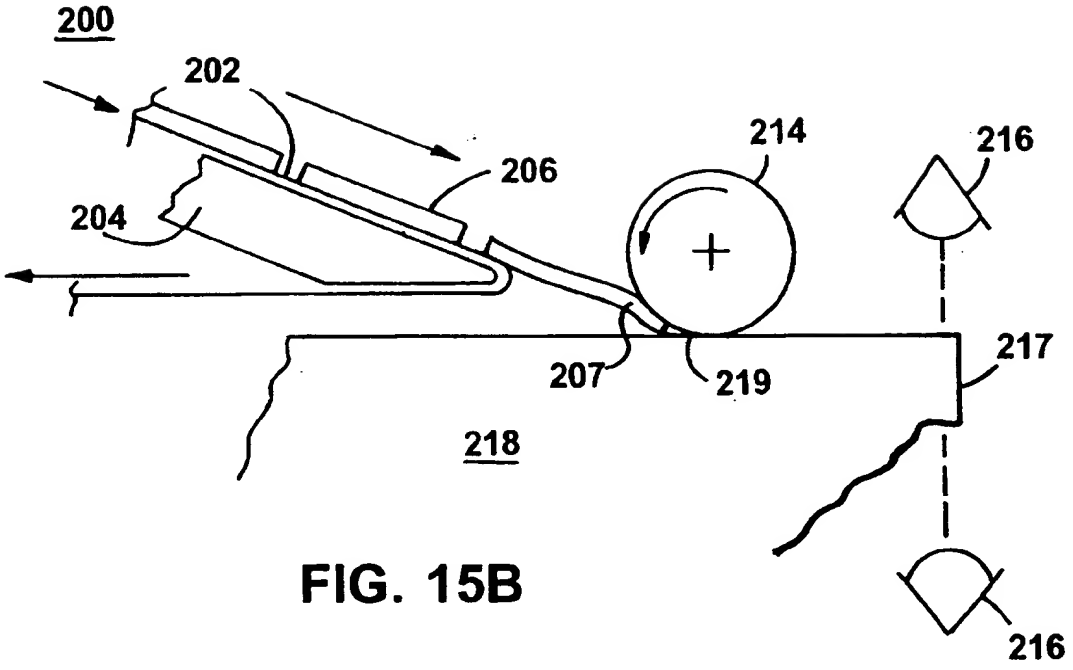


FIG. 15B

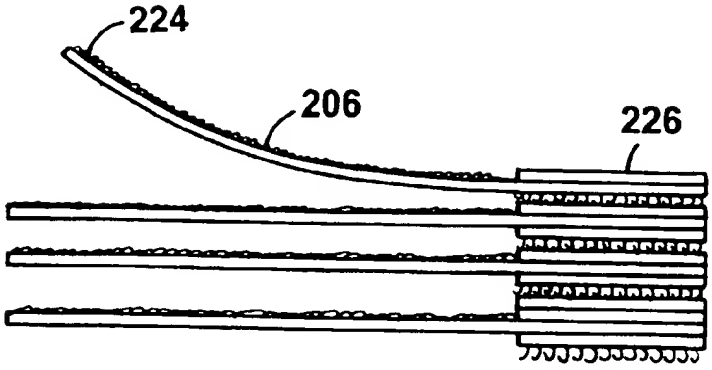


FIG. 16A

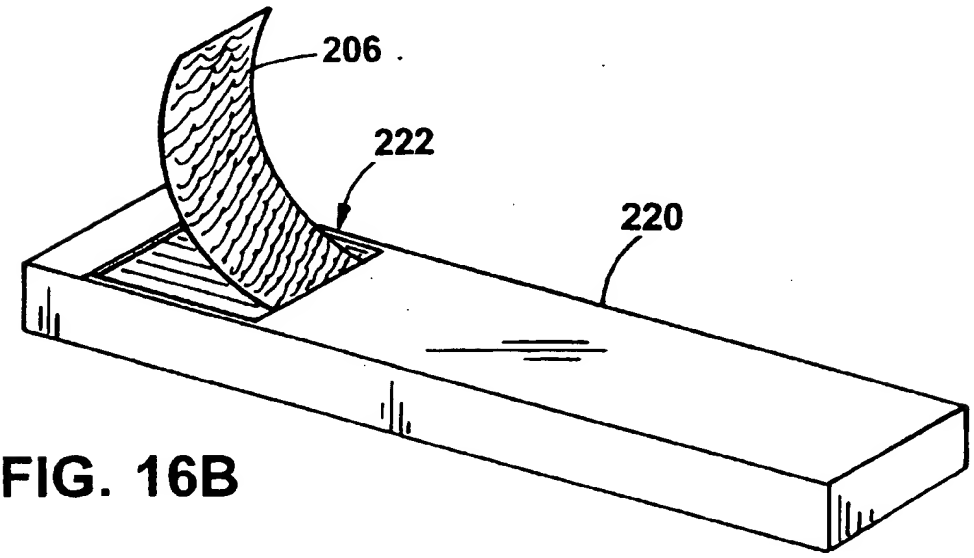


FIG. 16B

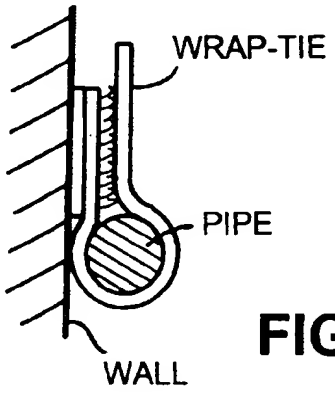


FIG. 17

COMPOSITE HOOK AND LOOP FASTENERS, AND PRODUCTS CONTAINING THEM

BACKGROUND OF THE INVENTION

This invention relates to composite hook and loop fasteners, methods of their manufacture and products containing them.

A typical composite hook and loop fastener is produced by taking preformed hook and loop material and overlapping and attaching the two materials together along their edge margins or by totally overlapping one on top of the other. The attaching is usually done by ultrasonic welding, thermal fusing or an adhesive bond. This step of attaching preformed hook and loop material to form the composite fastener adds additional cost to the manufacturing process. Hook and loop materials may also be laminated in-situ during the formation of the hook component.

One particular application for an improved composite fastener, discussed in more detail below, is as a wrap tie for closing bags. An economical bag tie commonly used in retail stores comprises a wire covered with paper. The wire tie is wrapped around an open end of a bag and the ends of the wire are twisted together to close the bag. Another common type of a bag tie is a clip tie that consists of a piece of plastic with an opening. A gathered open end of the bag is pushed through the side of the opening to close the bag. Other closures include strings and tapes and closing arrangements that employ adhesives or removably engageable elements.

The wire ties and clip ties are often used in retail stores where items such as bakery products, fresh produce, dry goods, nails, etc. are placed in a bag and sold by weight or number. The consumer usually stores these products in the bags. The ties may be opened and closed several times before the bag is emptied. There is a need for low-cost dependable repeated-use closures for this and many other applications.

SUMMARY OF THE INVENTION

A composite hook and loop fastener in the form of an elongated strip includes a loop component, a hook component permanently affixed to the loop component, and a backing layer disposed on a face of the wrap tie in a discrete region. The backing layer is used for permanent attachment of the wrap tie to a supporting surface. One end of the loop component is available for encircling an object to be wrapped and engaging the fastener elements of the hook component. The loop component has a self-supporting web of entangled fibers, the fibers forming both a sheet-form body and hook-engageable, free-standing loops extending from at least one surface of the body, and the hook component has fastener elements extending from a common base.

In general, in one aspect, the invention provides a wrap tie in the form of an elongated strip. The wrap tie has an elongated loop component having a web of fibers forming both a sheet-form body and hook-engageable loops extending from at least one surface of the body, a hook component permanently affixed to a first end of the loop component, the hook component comprising a base of synthetic resin and an array of loop-engageable fastener elements integrally molded with and extending from a first surface of the base, and a backing layer permanently affixed to a second surface of the base opposite the fastener elements, for permanent attachment of the wrap tie to a supporting surface. A second end of the loop component is available for encircling an object to be wrapped and engaging the fastener elements of the hook component.

Implementations of this aspect of the invention may include one or more of the following features. The web of the loop component may be non-woven and specifically a needled non-woven. The non-woven needled web may weight less than about 2 ounces per square yard (68 grams per square meter). The non-woven web may be in a stretched, stabilized state. The loops of the loop component may extend from loop structures, and at least some of the loop structures may each have a common, elongated trunk portion extending from the web from an associated knot and multiple loops extending from the trunk portion. The loop component may have an edge margin encapsulated in resin of the hook component, and a remainder free of hook component resin. The edge margin may be about 10% of the area of the loop component. The loop component may have an entire face encapsulated in resin of the hook component. The loop component may have two broad, opposite sides, and loops may extend from both sides. The hook component may be shorter than the loop component, as measured along the wrap tie, and the backing layer may overlap longitudinally the hook component and may be disposed on a side of the wrap tie opposite the fastener elements. The fastener elements of the hook component may be hook- or mushroom-shaped. The hook component may be disposed at one end of the elongated wrap tie, and the hook-shaped fastener elements may extend toward the other end of the wrap tie. The base of the hook component may include an integral extension void of fastener elements, for overlapping the loop component and for face-to-face attachment. The backing layer may be a pressure sensitive adhesive or a synthetic resin. A removable release liner may cover the pressure sensitive adhesive layer. The release liner may overlap longitudinally the loop component such that a portion of the release liner is exposed for grasping.

According to another aspect of the invention, a wrap tie has an elongated hook component having a base of synthetic resin and an array of fastener elements extending from a first surface of the base, a loop component permanently affixed to a first end of the hook component, the loop component having a web of fibers forming both a sheet-form body and hook-engageable loops extending from at least a first surface of the body, and a backing layer permanently affixed to a second surface of the body of loop component for permanent attachment of the wrap tie to a supporting surface. A second end of the hook component is available for encircling an object to be wrapped and engaging the hook-engageable loops of the loop component. The hook component may be in a stretched state.

According to another aspect of the invention, a bag has an open end and an elongated, strip-form wrap tie according to this invention, permanently affixed to an outer surface of the bag for closing the open end. The wrap tie is permanently bonded to the outer surface of the bag in a discrete region along the length of the wrap tie. One end of the loop component is available for encircling the open end of the bag to secure the bag in a closed state. The wrap tie may be permanently affixed to the bag by a pressure sensitive adhesive layer or a synthetic resin. The bag may be made of synthetic resin or paper.

According to another aspect of the invention a sheet-form composite touch fastener includes a loop component having a self-supporting non-woven web of entangled fibers, the fibers forming both a sheet-form web body and hook-engageable free-standing loops extending from at least one surface of the web body, and a hook component having a base of synthetic resin to which loop-engageable hooks are integrally molded. The resin of the hook component extends

at least partially underneath the loop component and encapsulates fibers of the web body of the loop component.

Implementations of this aspect of the invention may include one or more of the following features. The loop component may have an edge margin encapsulated in resin of the hook component, and a remainder free of hook component resin. The edge margin may be about 10% of the area of the loop component. The loop component may have an entire face encapsulated in resin of the hook component. The loops of the loop component may extend from a common side of the sheet-form touch fastener. The loops of the loop component may be arranged on a side of the sheet-form composite touch fastener opposite to the hooks of the hook component. The fibers of the loop component may be encapsulated in the resin of the hook component and the loop component may comprise regions which are more encapsulated by resin than other regions.

According to another aspect of the invention a sheet-form composite touch fastener includes a sheet-form loop component having a web of fibers forming both a sheet-form web body and hook-engageable loops extending from at least one surface of the web body and a sheet-form hook component comprising a base of synthetic resin to which loop-engageable hooks are integrally molded. One edge region of the hook component is permanently attached to a first edge of the loop component and fibers of the first edge of the loop component are encapsulated by resin of said edge region of the hook component. The loop component has a second edge, opposite said first edge, substantially free of resin of the hook material.

According to another aspect of the invention a method is provided for manufacturing the elongated, strip-form wrap ties of this invention. The method includes the following steps: Provide a longitudinally continuous sheet of a loop material of finite width, the loop material having loops extending from at least a first surface. Permanently bond a longitudinally continuous strip of plastic hook material to the loop material to form a laminate, with the hook material at least partially overlapping the loop material widthwise and having a width significantly less than the width of the loop material, the hook material having a strip-form base and fastener elements integrally molded with and extending from the strip-form base. Apply pressure sensitive adhesive to a predetermined region of a side of the laminate opposite the fastener elements. Cut the laminate to form the wrap ties, each wrap tie having a portion of the loop material, a portion of the hook material, and a layer of the adhesive.

Implementations of this aspect of the invention may have one or more of the following features. For a wrap tie that has a removable release liner covering the layer of adhesive, the method further includes, before the step of cutting, applying a longitudinally continuous release liner to the laminate to cover the adhesive. The cutting at least perforates the loop material and the base of the hook material to define longitudinal edges of the individual wrap ties, and leaves the release liner longitudinally continuous. The cut wrap ties may be spooled upon the continuous release liner for subsequent separation. The hook material may be bonded to the loop material by ultrasonic welding, thermal welding, or pressure sensitive adhesive. The step of bonding may also include continuously feeding the loop material through a nip defined between a rotating mold roll and a pressure roll, the rotating mold roll defining a multiplicity of fixed cavities about its periphery for molding the fastener elements of the hook material, while continuously introducing molten resin to the mold roll under conditions which cause the resin to fill the cavities of the mold roll and form the hook material, such that pressure in the nip bonds the loop material to the hook material. The molten resin may be introduced to the mold roll in multiple, discrete regions along the roll, thereby forming multiple, parallel strips of hook material laminated to the loop material. After the bonding step and before the cutting step, the laminate is slit longitudinally into multiple, longitudinally continuous bands, each band including both hook material, loop material and adhesive. The loop material may be fed through the nip in the form of multiple parallel strips, while forming the hook material to fill gaps between adjacent strips of hook material in the nip.

According to another aspect of the invention a method is provided for manufacturing the elongated strip-form wrap ties of this invention. The method includes the following steps: Provide a longitudinally continuous sheet of a loop material of finite width, the loop material having loops extending from at least a first surface of the loop material. Provide a longitudinally continuous strip of plastic hook material, the hook material having a width significantly less than the width of the loop material, the hook material having a first surface with fastener elements integrally molded with and extending from the first surface, and a second surface, opposite the first surface, having a layer of pressure sensitive adhesive. Bond the hook material and loop material along their length, with the loop material overlapping a longitudinal edge of the hook material and leaving the layer of adhesive uncovered by loop material. Cut the laminate to form the wrap ties, each wrap tie having a portion of the loop material, a portion of the hook material, and a layer of the adhesive.

According to yet another aspect of the invention a method is provided for manufacturing a sheet-form composite touch fastener. The method includes the following steps: Provide a longitudinally continuous sheet of a loop material of finite width, the loop material having a self-supporting non-woven web of entangled fibers, the fibers forming both a sheet-form web body and hook-engageable free-standing loops extending from at least one surface of the web body, said loop material having a substantially constant fiber density across its width. Permanently bond a longitudinally continuous strip of plastic hook material to the loop material to form a laminate, the hook material having a strip-form base of synthetic resin with fastener elements integrally molded with and extending therefrom and wherein said synthetic resin of the base of the hook component extends at least partially underneath the loop component and encapsulates fibers of said web body of the loop component. Cut the laminate to form the composite touch fasteners, each composite touch fastener having a portion of said loop material, and a portion of said hook material.

According to yet another aspect of the invention an apparatus is provided for manufacturing the elongated, strip-form wrap ties of this invention. The apparatus includes a cooled, rotating forming roll defining a plurality of inwardly extending, fixed fastener element cavities at its periphery; a pressure roll positioned to cooperate with the forming roll to define a nip, the pressure roll having an outer surface for supporting a continuous sheet of a loop material fed into the nip; and an extrusion nozzle positioned to direct a continuous flow of molten resin toward the forming roll under conditions which cause the resin to fill the fastener element cavities and to form a continuous layer of resin against the forming roll, such that the layer of resin is bonded to the loop material by pressure in the nip, to form a laminate. The apparatus further includes an applicator arranged to apply a longitudinally continuous layer of pressure sensitive adhesive, to a discrete region of a side of the laminate

opposite the fastener elements; a guide arranged to direct a longitudinally continuous release liner to cover the applied layer of adhesive; and a blade arranged to cut in a transverse direction across the laminate to form individual wrap ties.

According to yet another aspect of the invention a method is provided for releasably securing a container in a closed state. The method includes providing a wrap tie according to this invention; permanently adhering the wrap tie to a surface of the container; wrapping one end of the loop component about the container; and engaging the fastener elements of the hook component with the loops of the loop component to retain the container in a closed state.

Among the advantages of the invention may be one or more of the following. The wrap-tie of this invention does not have any sharp or metal parts, which may cut the bag when they become exposed, pose injury risk for the consumer or oxidize and thus contaminate the bag and its contents. There is no preferred direction or need to twist the wrap tie, thus making it easy to open and close the bag opening. Further the wrap tie of this invention can be pre-attached to a bag automatically or can be dispensed from a wrap tie dispenser for manual attachment to a bag. The very low thickness and stiffness of both the non-woven loop material and the hook material, along with its low cost and good closure performance, make the wrap tie a particularly useful component of many products.

Other features and advantages of the invention will be apparent from the following description of embodiments, and from the claims.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a wrap tie having an elongated loop component overlapping an end of a short hook component and adapted for permanent union with a bag or similar article.

FIG. 1A is a perspective view of a bag having the wrap tie of FIG. 1 attached to its surface.

FIG. 1B is a side view of a wrap-tie having loops on both sides of an elongated loop component.

FIG. 1C is a side view similar to FIG. 1B, of a wrap-tie having an elongated loop component, an end portion of which overlaps the entire back surface of a hook component.

FIG. 1D is a side view of a wrap-tie in which a hook component is attached in the middle of an elongated loop component.

FIG. 1E is a side view of a wrap-tie in which an elongated stretched hook component overlaps an end of a short loop component.

FIG. 1F is a side view of a wrap-tie in which the hook strip is attached face-to-face to the loop strip.

FIG. 2A illustrates a preferred non-woven loop material for use as a loop component, enlarged 50X.

FIG. 2B is a schematic view of the face of the non-woven loop material shown in FIG. 2A.

FIG. 2C is a sketch of the non-woven loop material illustrating clusters of loop fibers extending from a fibrous mat.

FIG. 3 is a side view of a twisted wrap tie according to the invention.

FIGS. 4A and 4B are perspective magnified views of portions of a hook fastener and a stretched hook fastener, respectively.

FIG. 5 illustrates an apparatus for forming and uniting components of a wrap tie.

FIGS. 6A is a perspective view of a portion of the apparatus of FIG. 5 for forming the preform product of FIG. 7, while FIG. 6B is a view taken in plane 6B—6B of FIG. 6A.

FIG. 7 illustrates a web comprised of attached loop and hook bands formed with the apparatus of FIGS. 5, 6A and 6B.

FIG. 8 is a perspective view of four hook and loop segments formed by slitting the web shown in FIG. 7.

FIG. 9 is a top view of a hook and loop segment that has been perforated cut.

FIG. 10 is an enlarged side view of the hook and loop segment, taken along line 10—10 in FIG. 9.

FIG. 11 is a cross sectional view of the interface between the hook and loop segments, taken along line 11—11 in FIG. 10.

FIG. 12 is an enlarged side view of area 12 in FIG. 10.

FIG. 13 illustrates reciprocating ultrasonic welding of bands of hook and loop material to form a wrap tie preform.

FIG. 13A illustrates rotary ultrasonic welding of bands of hook and loop material to form a wrap tie preform.

FIG. 14 illustrates thermal fusing of bands of hook material and loop material to form a wrap tie preform.

FIG. 15 is a schematic illustration of an apparatus that dispenses wrap ties from a carrier sheet.

FIG. 15A is a schematic illustration of area A in FIG. 15.

FIG. 15B is a schematic illustration of an automatic label dispensing apparatus.

FIG. 16A is a side view of stacked wrap ties.

FIG. 16B is a schematic illustration of a box dispenser for the stacked wrap ties of FIG. 16A.

FIG. 17 is a schematic illustration of an application of a wrap tie as a support of a pipe against a wall.

DESCRIPTION OF EMBODIMENTS

Referring to FIG. 1, a wrap tie **100** features an elongated strip of non-woven loop material **110**, attached to a short strip of hook material **120**.

The strip of non-woven loop material has a first surface **114** with hook-engageable loops **112** and a second relatively smooth surface **116**. The strip of hook material **120** has a first surface **122** with integrally molded fastener elements **126** and a second smooth surface **124**. The fastener elements may be hook- or mushroom shaped. The hook-shaped fastener elements extend toward the loop material. The smooth surfaces of the hook and loop strips overlap distance d and are attached at joint **128** so that the loops and hooks extend in opposite directions of the wrap tie. A pressure sensitive adhesive layer **130** covers the remainder of the smooth surface **124** of the hook strip **120**. For a face-to-face attachment of the hook and loop strips (FIG. 1F), i.e., attaching the surface of the loop strip having the loops to the surface of the hook strip having the hooks, the base portion of the hook strip **120** has an integral extension **129** without hooks for overlapping the loops of the loop strip **110**. The pressure sensitive adhesive layer **130** is covered with a release liner **132**, such as silicon coated paper. The release liner **132** overlaps longitudinally the loop component such that a portion of the release liner is exposed for grasping. In one example, the tie is 0.5 inch wide, dimension w, the loop strip is 3 inch long, dimension l, the hook strip is 0.75 inch long, dimension l_1, and the overlap area **128** is 0.4 inch long, dimension d, all components having the same width w. The thickness of the loop material may vary between about 0.150

inch and 0.0100 inch, and the thickness of the hook material may vary between about 0.100 inch and 0.010 inch.

Referring to FIG. 1A, the wrap tie of FIG. 1 is attached to an open end of a bag by the adhesive layer. The elongated non-woven loop strip is wrapped around the bag opening and the free end of the loop strip is secured to the hook strip by engaging the loops with the hooks. The wrap tie may be prefastened and integrated with the bag, e.g., during manufacture of the bag, or it may be applied to the bag at the time of its use, by removing the release layer and pressing the adhesive component against the material of the bag. The bag may be made of synthetic resin or paper. In some instances the wrap tie may have, instead of the pressure sensitive adhesive layer, a synthetic resin layer which can be thermally fused to the bag surface.

In such applications in which the products are considered disposable after single use, the loop material only need withstand a relatively small number of hooking cycles (e.g., 3 to 5) over the product's useful life. We refer to these as "low cycle" applications. Loop products in this category may be fabricated to advantage with needled fabric that has needle-formed loops on one or both sides. In certain cases, the material is in a permanently stretched and stabilized state, having been stretched to increase its area in excess of 100%, as much as 150% or more from its as-needled condition. A preferred needled and stretched material is formed of staple polyester yarns of between about 18 and 4 denier, preferably 6 denier.

Other applications, such as strapping or bundling, may require the hook-engageable loops to withstand a higher number of cycles and higher stress. These relatively "high cycle", high strength applications generally are preferably achieved by using woven or knitted material or by forming loops with higher denier (or higher tenacity) fibers than those suitable for lower performance conditions. Loop products in this category may be prepared by stretching an appropriate needled loop fabric in the range of 50 percent to 100 percent stretch, for example, followed by stabilization.

For certain applications, specially treated loop material may be used in a wrap tie. For example, on a bag that holds an electronic device and needs to dissipate static electricity, non-woven loop impregnated with carbon or stainless steel may be used. Carbon or stainless steel fibers may also be blended with staple fiber to form a static electricity dissipative non-woven loop material. A two-sided non-woven loop material may be used on a wrap tie that, no matter if twisted, can be fastened to the hook.

Additional configurations of a wrap tie include among others the following: the loop strip **110** has loops on both surfaces **114** and **116** (FIG. 1B), the loop strip **110** overlaps and attaches to the entire smooth surface **124** of the hook strip **120**, with the adhesive layer **130** being intimately bonded to the loop side **114** of the strip(FIG. 1C), the hook strip **120** attaches to the middle of the loop strip **110** (FIG. 1D), and an elongated hook strip **120**, which may be of formed and stretched material, is attached to a short loop strip **110**(FIG. 1E).

In preferred embodiments, the non-woven loop material **110** (FIG. 1) is very thin, but still self-supporting, and has relatively free fibers forming loops extending from one side or both sides of a continuous, tangled mat of fibers. In preferred embodiments the non-woven loop material **110** comprises a needled fabric of staple fibers which has been stretched longitudinally and transversely, to form a fabric of the form depicted in FIGS. 2A and 2B.

In such a fabric the individual fibers of the mat follow no definite pattern as in a woven product, but extend in various directions within the plane of the fabric mat. The loops that extend from the loop product are of the same fibers that comprise the mat but extend beyond the general mass of the mat, out of the plane of the mat, generally from associated knots **180**, in the form of well anchored loop trees **250** (FIG. 2C).

As shown in FIG. 2A, and in the diagram of FIG. 2B, in relatively low density fiber regions of a preferred mat a substantial number of the fibers of the mat of loop material **110** are taut (i.e., not slack, regionally straight), and extend between knots **180** of the loop material fabric. The taut fibers **182** have been straightened by tension applied in at least one direction in the plane of the fabric mat **170**, while the knots have been produced by slippage and agglomeration caused during the application of stretching forces to the needled non-woven fabric.

The knot density of the sample shown in the photograph was determined to be approximately 180 knots per square inch by counting the number of visible knots within a given square area. The knots themselves are fairly tight, made up of several monofilament fibers, and are interconnected by the taut fibers seen running between them. Between knots, the thin fiber mat is not very dense and is sheer enough to permit images to be readily seen through it. For low cost applications, the fabric preferably weighs less than about 2 ounces per square yard (68 grams per square meter).

In this particular embodiment, the fibers of the mat are held in their taut, straightened condition by a water-based, acrylic binder (not visible in the Figure) applied to the side of the mat opposite the loops to bind the mat fibers in their straight condition to stabilize the areal dimensions of the fabric, and to secure the loops at their associated knots. The binder generally ranges between 20 and 40% of the total weight of the fabric and in the presently preferred embodiments accounts for about one third of the total weight of the loop component. The resulting fabric is dimensionally stable and strong enough to be suitable for further processing by standard fabric-handling techniques. While the fabric has a slight stiffness, like a starched felt, the stiffness can be mitigated where desired by softeners or mechanical working.

As seen in FIG. 2C, loops **112** extend from free-standing clusters of loop fibers extending from the fibrous mat **170**. The clusters **250** which have several mono-filament loops **112** extending from a common elongated, substantially vertical trunk **252** we call "loop trees". Each loop tree **250** extends from a corresponding knot **180** in which the loops of the cluster are anchored. Interstices between individual filaments in the trunk portion **252** of each tree or at the base of each bush, and in each knot **180** provide paths for the wicking of liquid binder, under the influence of surface tension of the liquid binder, to provide additional localized stiffness and strength. Importantly, the density of clusters in the plan view is very low, leaving sufficient room between the "branches" of neighboring trees to accommodate hooks and deflected loop material during engagement.

A more complete description of suitable non-woven loop materials may be found in U.S. patent application Ser. No. 08/922,292, and a related PCT patent application entitled "Loop material, its manufacture and its use in products", filed on Sep. 3, 1998, as a continuation in part of the foregoing application, the entire disclosures of which are hereby incorporated by reference.

Referring to FIG. 3, the flexibility of the non-woven material **110** allows it to be twisted several times and fastened on the hook fastener strip **120**. Even if there are

loops on only one face of the strip, hook engageable loops occur at all quadrants of the twist, to ensure engagement with the hook component. Further the loops around the slit edges of the loop strip are oriented in line with the fibrous mat **170**, making the edges hook engageable.

A hook strip **120** compatible with the loop material is used. For a non-woven loop material made from staple polyester fibers having a denier of 6, a hook may be of the CFM-29 designation, available from Velcro USA Inc. of Manchester, N.H., U.S.A. The CFM-29 hook strip has hooks of only 0.015 inch (0.38 mm) height. Especially when the hook component is the elongated component as depicted in FIG. **1E**, the hook strip may be a stretched hook product. Referring to FIGS. **4A** and **4B**, when a hook product is subjected to lateral stretching, the material of the base web **150** decreases in thickness, from the original thickness t_0 of FIG. **4A** to the reduced thickness t_1 of FIG. **4B**. The areal density of the fastener elements is accordingly reduced. For example, with hook form elements of a type having a conventional height of about 0.035 inch and a spacing l_o of about 0.050 inch along the rows, starting with a spacing w_o of the rows of about 0.025 inch and ending with a spacing w_1 of FIG. **4B** of about 0.100 inch, the areal density changes by a factor of 4, from about 800 fastener elements 11 per square inch to about 200 fastener elements per square inch. Starting with higher hook densities, higher final densities can be achieved to match the hooking needs of particular applications, while still of low cost.

The product of FIG. **1** may be economically formed by the process and apparatus illustrated in FIG. **5**. Extruder barrel **308** melts and forces the molten plastic **310** through a slot-form die **312**. The extruded plastic enters the nip **314** between base roll **316** and mold roll **318** containing mold cavities shaped to form the hooks of a strip-form hook fastener component of the well known hook and loop type. The strip fastener material formed in nip **314** travels about the periphery of mold roll **318** to stripping roll **320**, which assists in pulling the finished product **300** from the mold roll, and from there to a windup device, not shown.

For more detail about the general operation of the apparatus of FIG. **5**, the reader is referred to U.S. Pat. No. 5,260,015 to Kennedy, et al., which discloses laminates made with loop materials.

There are many possible methods of feeding the non-woven sheet material to the forming section of the hook forming device. In one example, shown in FIGS. **6A** and **6B**, several transversely spaced apart bands of non-woven material **350** are introduced about the periphery of the base roll **316** and enter nip **314** at the same time molten plastic **310** enters the nip at regions between the bands of loop material. The slot-form die has alternating plugs and open die spaces, the spaces arranged to provide molten resin that fills the spaces **352** between the bands of the non-woven loop material and produce limited overlap of the resin and the bands of non-woven (FIG. **6B**), for forming joints **128**. The edge margins of the bands of non-woven material bond intimately with the edge margins of the molten resin with which bands of hook fasteners **354** are integrally formed. The bond is formed by encapsulating fibers of the loop material with the molten resin of the hook material. Thereby a composite structure of joined alternating bands of loop component and hook component are formed.

In one example, a web includes (FIG. **7**), starting from the left, a 3 inch wide strip of non-woven loop, an inch and a half wide strip of hook material, a 6 inch wide strip of non-woven loop, an inch and a half wide strip of hook material and a 3 inch wide strip of non-woven loop. The alternating strips of non-woven and hook material overlap partially, being bonded at joints **128**. The overlap areas are for instance 0.4 inch wide. After formation, the web passes through a slitter where it is longitudinally slit at the midpoints A and C of the hook segments, and at the midpoint B of the 6 inch loop segment. This results in four continuous length composite webs, each comprising a narrow band of hook material joined to a relatively wide band of non-woven loop material (FIG. **8**).

In the next step each of the four webs passes through a coating line where a pressure-sensitive adhesive is applied to the back of the hook strip material, this followed by a step where a release liner is placed on the adhesive layer.

At that point each of the four continuous webs is perforated-cut (kiss-cut) along lines **400** through the loop and hook side but not through the release liner **132**, as shown in FIGS. **9**, **10**, and **12**, to form a series of elongated bag ties. The direction of the kiss-cut **400** is perpendicular to the longitudinal axis **402** of the composite web, which coincides with the machine direction. A cross section of the web along the indicated direction **11—11** is shown in FIG. **11**.

An alternative way to manufacture the wrap tie is to ultrasonically seal respective preformed bands of hook and loop material. The two materials are slit to the appropriate width and their edges overlapped and ultrasonically welded with a reciprocating ultrasonic welder, as shown in FIG. **13**, or a rotary ultrasonic welder, as shown in FIG. **13A**. The back of the hook material is coated with pressure-sensitive adhesive prior to welding.

Another way to manufacture the wrap tie is to thermally fuse overlapping edge margins of preformed bands of hook and loop materials. Thermal fusing is performed with two rotary wheels **160** and **162**, shown in FIG. **14**. Both rotary wheels are heated, and may have a knurl pattern on them. The wheels come in contact and nip the area to be joined, which in this case is the overlap area between the edges of the loop and hook bands. The heated wheels melt the hook resin and fuse it into and around the fibers of the non-woven loop, thereby forming a bond between the margin portions of the two bands. The mechanical surrounding of the fiber with the melted, then solidified resin provides the necessary bond strength.

Different type of resins may be used to form either the hook or the non-woven material. In certain preferred cases, as mentioned, the non-woven material is made from polyester fibers and the hook material from polyethylene. The hook and loop material preferably differ in their heat properties. For example, the polyethylene melts at a lower temperature than the polyester and thereby allows the thermal fusing of the hook resin around the polyester fiber of the loop material, to form a strong mechanical bond with dimensional stability.

The adhesive for layer **130** is preferably a pressure sensitive type adhesive. In some instances, layer **130** may be a synthetic resin suitable for thermal fusion onto a substrate.

Wrap ties carried by a common release liner **202** may be rolled into a roll **210**. The wrap ties **206** have one end **208** attached to the release liner with the pressure sensitive adhesive and a free end **209**. The roll **210** may be fed to a standard labeler **200**, shown diagrammatically in FIG. **15**. The release liner is arranged to pass under a sharp angle **212** around a peel plate **204**, where it reverses direction. The release liner is flexible and can change easily direction. However, the wrap tie has a certain amount of stiffness that causes the edge of the wrap tie **207** not to follow the release

liner **202** around the peel plate **204**, and to protrude at the point where the release liner reverses its direction (FIG. 15A). In this way the peel plate automatically separates the wrap tie from the release liner. The wrap tie may either be indexed or dynamically placed upon a moving bag on a bagging machine which produces polyethylene bags. Automatic label dispensing on a moving bag is shown in FIG. 15B. The leading edge **217** of the moving bag **218** trips an electric eye **216**. The electric eye may be a light emitting diode. The electric eye **216** sends a signal to the label dispenser **200** and the dispenser accelerates and transports the wrap tie **206** towards the moving bag **218**. When the wrap tie **206** reaches a predetermined location **219** on the bag **218** and while the wrap tie is still connected to the release liner **202** a tamp roller **214** presses edge **207** of the wrap tie **206** onto the bag **218**. The wrap tie **206**, the bag **218**, and the release liner **202** continue to move at the same speed, while the tamp roller **214** presses the wrap tie onto the bag. Once the wrap tie is fully released from the release liner and attached to the bag, the release liner stops moving while the bag continues to move away from the dispenser region. The process repeats again when the next bag moves close to the dispenser area and trips the electric eye **216**. The advancement of the wrap ties may be controlled by a separate sensor (not shown) for increased accuracy.

When the backing layer **130** is made of synthetic resin, the tamp roller **214** is heated to thermally fuse the wrap tie onto the bag.

In another embodiment, the wrap ties **206** may be stacked one on top of the other (FIG. 16A), having one end **226** of each tie releasably adhered together and a free end **224**. The stacked wrap ties may be placed in a dispenser box **220** (FIG. 16B). The dispenser box has an opening **222**, allowing the free ends **224** of the wrap ties to be successively pulled out of the box.

Other features and advantages of this invention may include one or more of the following. The web in FIG. **7** may be first coated with the pressure sensitive adhesive and then pass through the slitter where it is longitudinally slit to form the hook and loop segments. The very low thickness of both the non-woven loop material and the hook material, along with its low cost and good closure performance, make the wrap tie a particularly useful component of many products. The wrap ties may be employed, for instance, to close a plastic bag as described above (FIG. **1A**), to secure pipes or other building materials (FIG. **18**), to bundle cables and secure bundled cables, etc.

Other features and advantages of the invention will be realized, and are within the scope of the following claims.

What is claimed is:

1. A wrap tie in the form of an elongated strip for closing a bag, the wrap tie comprising:

an elongated loop component having hook-engageable loops extending therefrom;

a hook component permanently affixed to a first end of the loop component at one end of the wrap tie, the hook component comprising

a base of synthetic resin; and

an array of loop-engageable fastener elements integrally molded with and extending from a first surface of the base; and

a backing layer permanently affixed to a second surface of the base opposite the fastener elements, for permanent attachment of the hook component of the wrap tie to a bag near an open end of the bag, with the elongated loop component free to be wrapped around the bag to engage the fastener elements of the hook component to close the bag.

2. The wrap tie of claim **1** wherein said loop component comprises a non-woven web.

3. The wrap tie of claim **2** wherein said non-woven web comprises a needled non-woven web.

4. The wrap tie of claim **3** in which the weight of the non-woven web is less than about 2 ounces per square yard (68 grams per square meter).

5. The wrap tie of claim **3** in which the non-woven web is in a stretched, stabilized state.

6. The wrap tie of claim **1** wherein the loops of the loop component extend from loop structures, at least some of the loop structures each comprising

a common, elongated trunk portion extending from the web from an associated knot and

multiple loops extending from the trunk portion.

7. The wrap tie of claim **1** wherein the loop component consists of an edge margin encapsulated in resin of the hook component, and a remainder free of hook component resin.

8. The wrap tie of claim **7** wherein the edge margin comprises less than about 10% of the area of the loop component.

9. The wrap tie of claim **1** wherein said backing layer comprises a pressure sensitive adhesive.

10. The wrap tie of claim **9** further comprising a removable release liner covering the pressure sensitive adhesive backing layer.

11. The wrap tie of claim **10** in which the release liner longitudinally overlaps the loop component such that a portion of the release liner is exposed for grasping.

12. The wrap tie of claim **1** wherein said backing layer comprises a synthetic resin.

13. The wrap tie of claim **1** wherein the loop component has two broad, opposite sides, both sides having exposed loops extending therefrom.

14. The wrap tie of claim **1** wherein the backing layer longitudinally overlaps the hook component and is disposed on a side of the wrap tie opposite the fastener elements.

15. The wrap tie of claim **1** in which the fastener elements of the hook component are hook-shaped.

16. The wrap tie of claim **1** in which the base of the hook component includes an integral extension void of fastener elements and overlapping the loop component in face-to-face attachment thereto.

17. A wrap tie in the form of an elongated strip for closing a bag, the wrap tie comprising:

an elongated hook component comprising a base of synthetic resin and an array of fastener elements extending from a first surface of the base;

a loop component permanently affixed to a first end of the hook component at one end of the wrap tie, the loop component comprising a web of fibers forming both a sheet-form body and hook-engageable loops extending from at least a first surface of the body; and

a backing layer permanently affixed to a second surface of the body of loop component for permanent attachment of the loop component of the wrap tie to a bag near an open end of the bag, with the elongated hook component free to be wrapped around the bag to engage the hook-engageable loops of the loop component to close the bag.

18. The wrap tie of claim **17** in which the elongated hook component is in a stretched state.

19. In combination,

the wrap tie of claim 1 or 17; and

a bag having an open end, the backing layer of the wrap tie permanently adhered to an outer surface of the bag near its open end, the wrap tie positioned to enable the wrap tie to be subsequently wrapped about the bag to engage the loops of the loop component with the fastener elements of the hook component to close the bag.

20. A bag having an open end and an elongated, strip-form wrap tie permanently affixed to an outer surface thereof for closing said open end, said wrap tie comprising

an elongated loop component having hook-engageable loops extending from at least a first surface of the wrap tie; and

a hook component bonded to the loop component at one end of the wrap tie, the hook component having fastener elements extending from a common base;

the wrap tie permanently bonded to the outer surface of the bag at its hook component, the loop component being available for encircling the open end of the bag to engage the hook component to secure the bag in a closed state.

21. The bag of claim 20 wherein the wrap tie is permanently affixed to an outer surface of the bag by a pressure sensitive adhesive.

22. The bag of claim 20 wherein the wrap tie is permanently affixed to an outer surface of the bag by a synthetic resin.

23. The bag of claim 20 wherein said bag comprises a synthetic resin.

24. The bag of claim 20 wherein said bag comprises paper.

25. A method of releasably securing a container in a closed state, the method comprising:

providing a wrap tie comprising

an elongated loop component having a self-supporting web of entangled fibers, the fibers forming both a sheet-form body and hook-engageable, free-standing loops extending from at least one surface of the body;

a hook component permanently affixed to one end of the loop component, the hook component having fastener elements extending from a common base; and

a backing layer disposed on a back face of the base of the hook component;

permanently adhering the backing layer to a surface of the container;

wrapping one end of the loop component about the container; and

engaging the fastener elements of the hook component with the loops of the loop component to retain the container in a closed state.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,205,623 B1
DATED : March 27, 2001
INVENTOR(S) : William H. Shepard and William Clune

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,

Under U.S. Patent Documents, please delete "5,868,407 7/99 Kato et al." and insert -- 5,868,844 2/99 Kato et al. --.

Signed and Sealed this

Sixth Day of November, 2001

Attest:

Nicholas P. Godici

Attesting Officer

NICHOLAS P. GODICI
Acting Director of the United States Patent and Trademark Office

US005547531A

United States Patent [19]

Allen et al.

[11] Patent Number: 5,547,531

[45] Date of Patent: Aug. 20, 1996

[54] **NONWOVEN FEMALE COMPONENT FOR REFASTENABLE FASTENING DEVICE AND METHOD OF MAKING THE SAME**

[75] Inventors: **Patrick J. Allen; Beverly J. Bross-Kelly**, both of Cincinnati; **Louis J. Viltro**, Hamilton; **William R. Vinnage, Jr.; David M. Weirich**, both of Cincinnati, all of Ohio

[73] Assignee: **The Proctor & Gamble Company**, Cincinnati, Ohio

[21] Appl. No.: **419,314**

[22] Filed: **Apr. 10, 1995**

Related U.S. Application Data

[62] Division of Ser. No. 254,814, Jun. 6, 1994, abandoned.

[51] **Int. Cl.**[6] **A61F 13/15**

[52] **U.S. Cl.** **156/164**; 156/163; 156/229; 156/495; 156/496; 604/391

[58] **Field of Search** 156/163, 164, 156/229, 160, 495, 496; 604/391; 26/88

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,039,312	5/1936	Goldman .	
2,397,838	4/1946	Chavannes .	
3,094,330	6/1963	Smith .	
3,176,364	4/1965	Dritz .	
3,214,323	10/1965	Russell et al. .	
3,266,841	8/1966	Altman .	
3,277,547	10/1966	Billarant .	
3,319,307	5/1967	Marforio .	
3,327,708	6/1967	Sokolowski .	
3,405,430	10/1968	Sidelman .	
3,469,289	9/1969	Whitacre .	
3,490,107	1/1970	Brumlik .	
3,494,006	2/1970	Brumlik .	
3,665,921	5/1972	Stumpf .	
3,665,922	5/1972	Skora .	
3,694,867	10/1972	Stumpf .	
3,708,833	1/1973	Ribich et al. .	
3,895,797	7/1975	Moore .	
3,949,128	4/1976	Ostermeier .	
4,116,892	9/1978	Schwarz .	
4,223,059	9/1980	Schwarz .	
4,355,066	10/1982	Newman .	
4,374,888	2/1983	Bornslaeger .	
4,379,192	4/1983	Wahlquist et al. .	
4,418,123	11/1983	Bunnelle et al.	156/244.11

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

0217032A3	4/1987	European Pat. Off. .
0258015	3/1988	European Pat. Off. .
0341993	11/1989	European Pat. Off. .
0604731A1	7/1994	European Pat. Off. .
0672516A2	9/1995	European Pat. Off. .
1140576	1/1969	United Kingdom .
1299897	12/1972	United Kingdom .
WO92/01401	2/1992	WIPO .
WO94/02158	2/1994	WIPO .
WO94/08789	4/1994	WIPO .
WO95/04654	2/1995	WIPO .

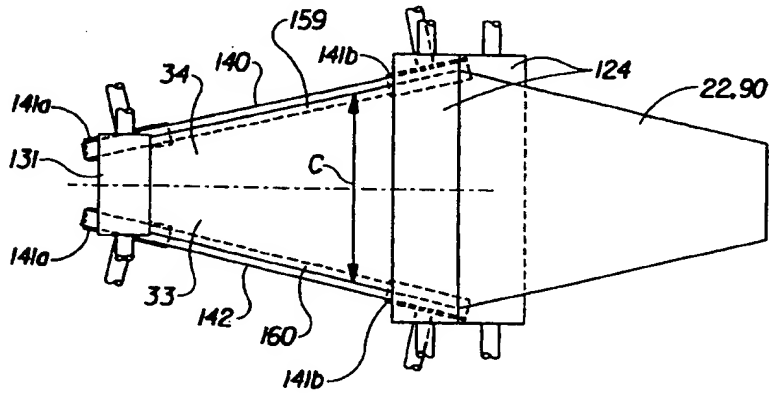
Primary Examiner—Jeff H. Aftergut

Attorney, Agent, or Firm—David M. Weirich; Steven W. Miller; Jacobus C. Rasser

[57] **ABSTRACT**

A female component for a refastenable fastening device having an elastomeric adhesive backing and a multiplicity of fibrous elements extending from the backing. The female fastening component is formed by a method comprising the steps of: providing a first lamina comprising an elastomeric, pressure-sensitive adhesive film having a first adhesive surface and a second adhesive surface opposed to said first adhesive surface, a relaxed orientation and an elongated orientation; stretching said first lamina from said relaxed orientation to said elongated orientation; contacting a second lamina comprising a nonwoven web with said first surface of said first lamina in said elongated orientation, thereby directly joining said second lamina and said first lamina to form a laminate; and relaxing said first lamina such that said second lamina is shirred to form catching regions capable of entangling the hooks of a complementary male fastening component.

25 Claims, 7 Drawing Sheets



U.S. PATENT DOCUMENTS

4,600,618	7/1986	Raychok Jr. et al. .	4,943,340	7/1990	Ujimoto et al.	156/229 X
4,725,473	2/1988	Van Gompel et al. .	4,973,326	11/1990	Wood et al. .	
4,761,318	8/1988	Ott et al. .	5,032,122	7/1991	Noel et al. .	
4,761,322	8/1988	Raley .	5,043,036	8/1991	Swenson	156/496 X
4,891,258	1/1990	Fahrenkrug .	5,185,052	2/1993	Chappell et al. .	
			5,308,345	5/1994	Herrin .	
			5,326,612	7/1994	Goulait .	

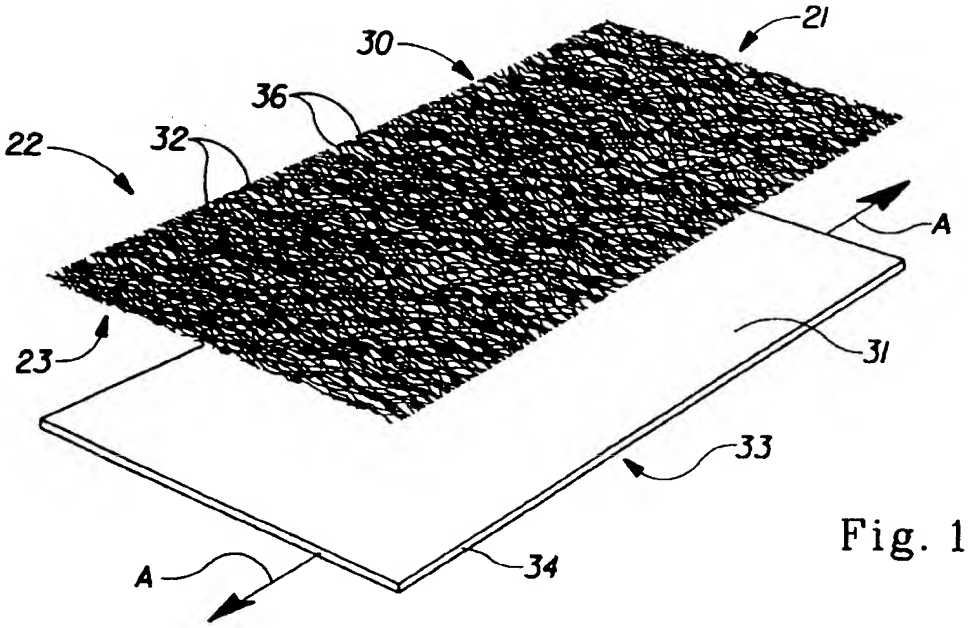


Fig. 1

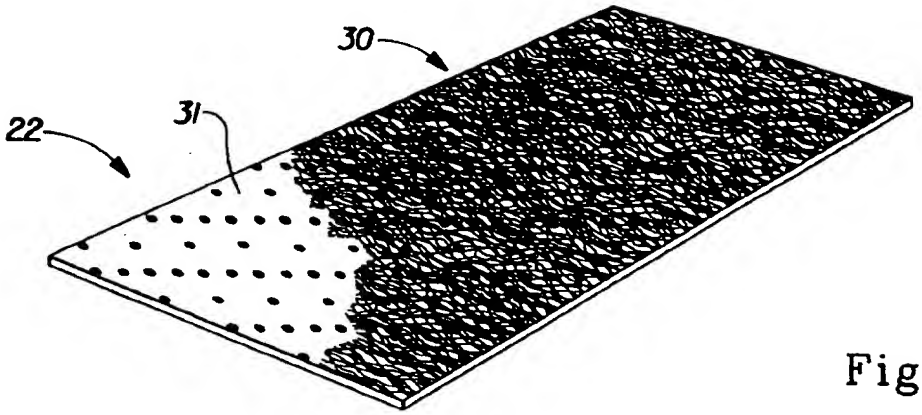


Fig. 2

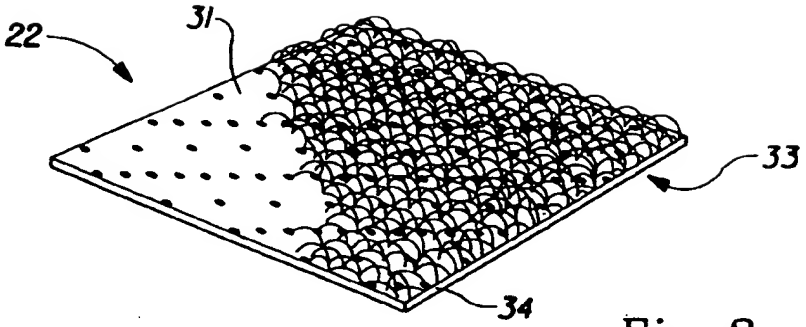


Fig. 3

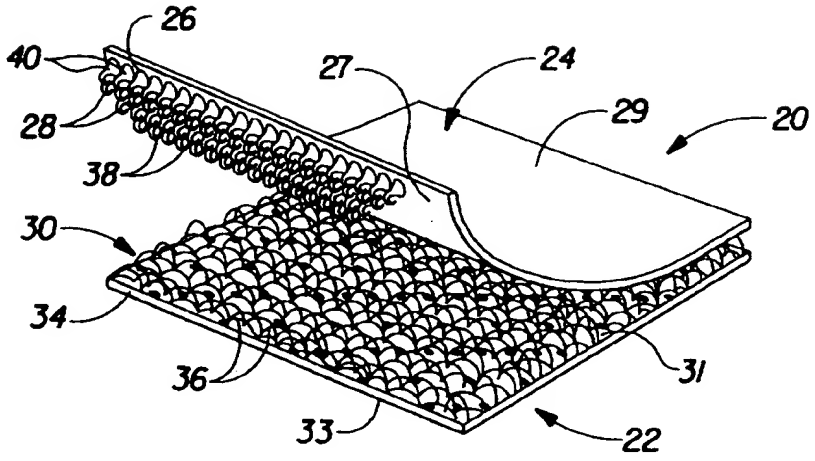


Fig. 4

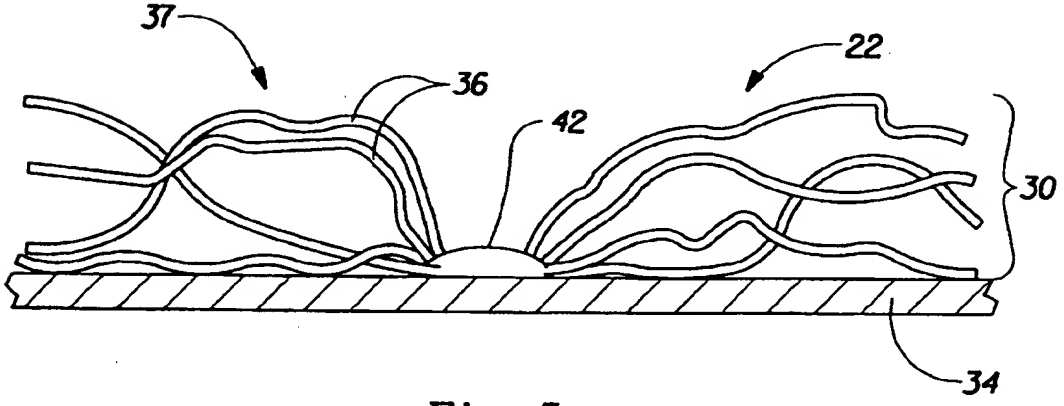


Fig. 5

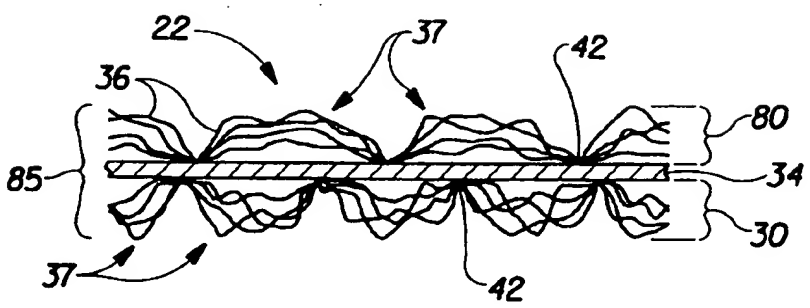


Fig. 6

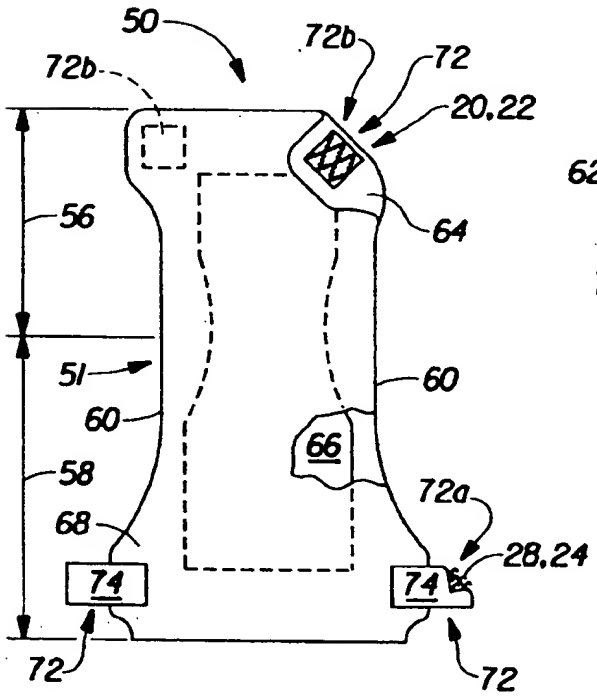


Fig. 7

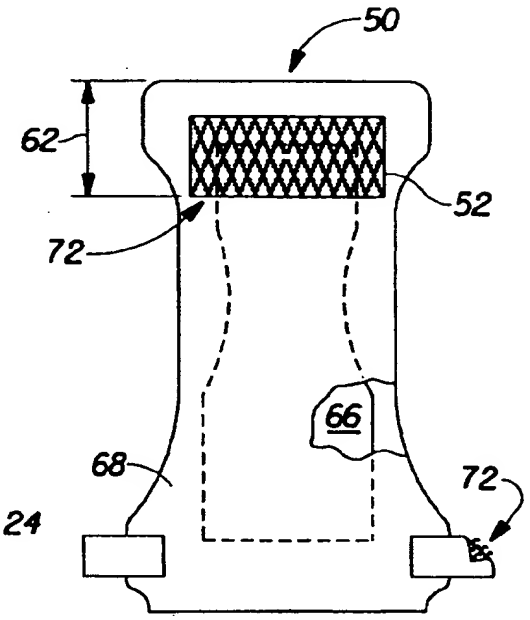
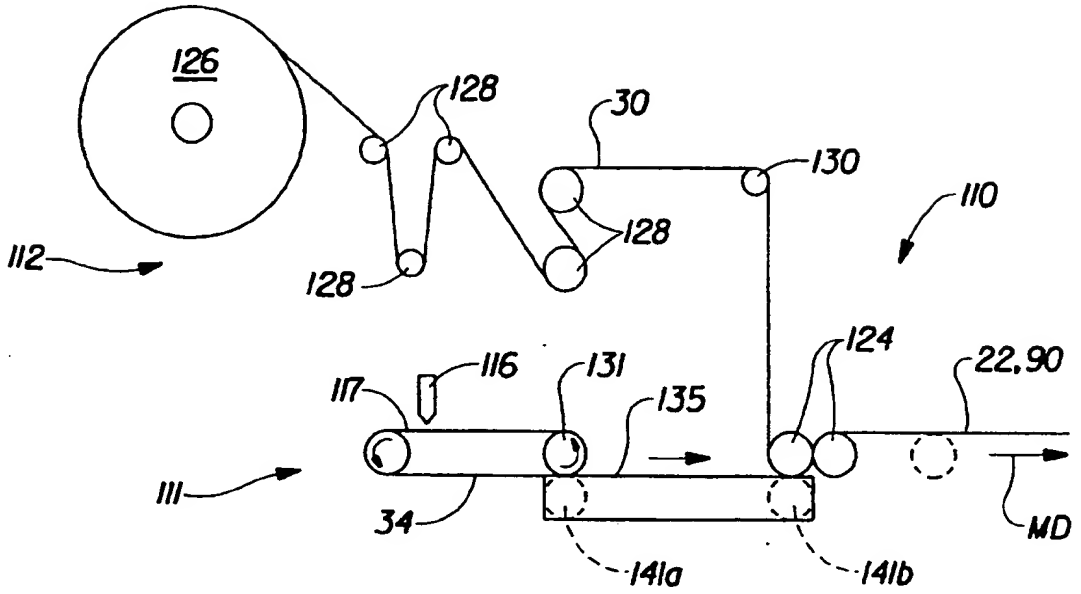


Fig. 8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128
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22,90
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131
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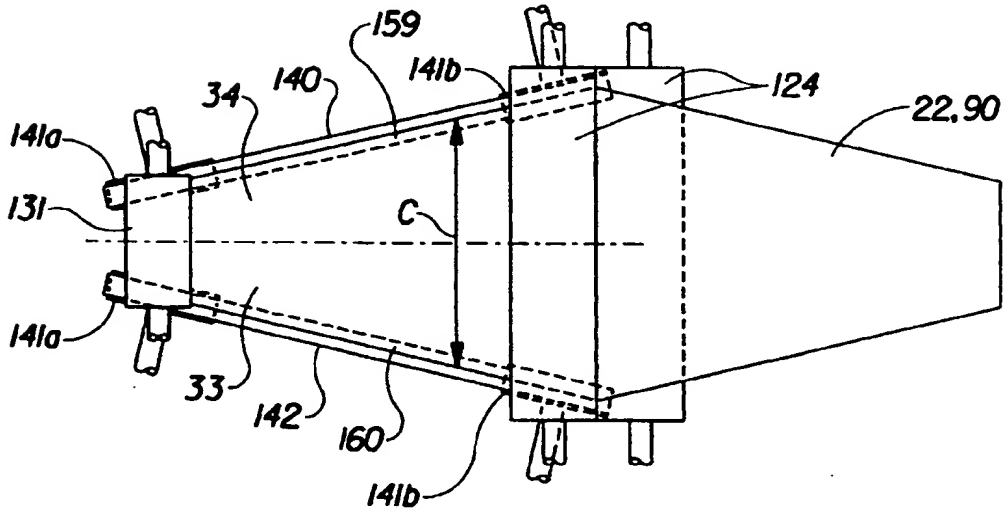
135
111
34
MD
141a
141b

Fig. 9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131
C
141a
33
142
160
141b

Fig. 10

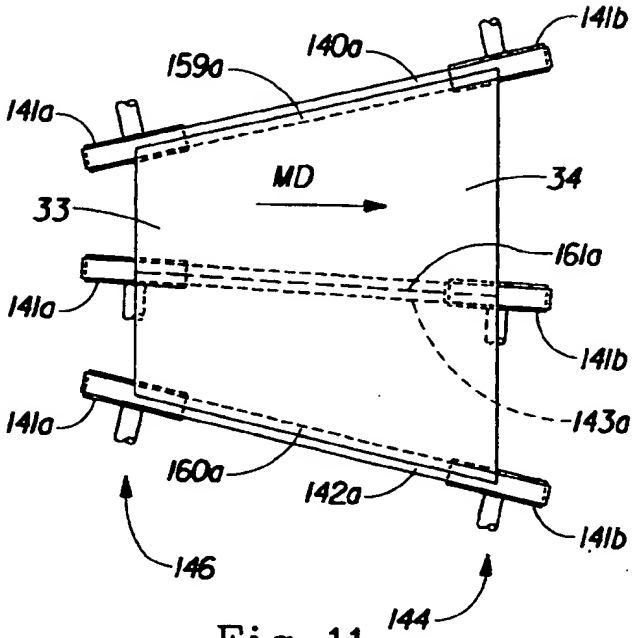


Fig. 11

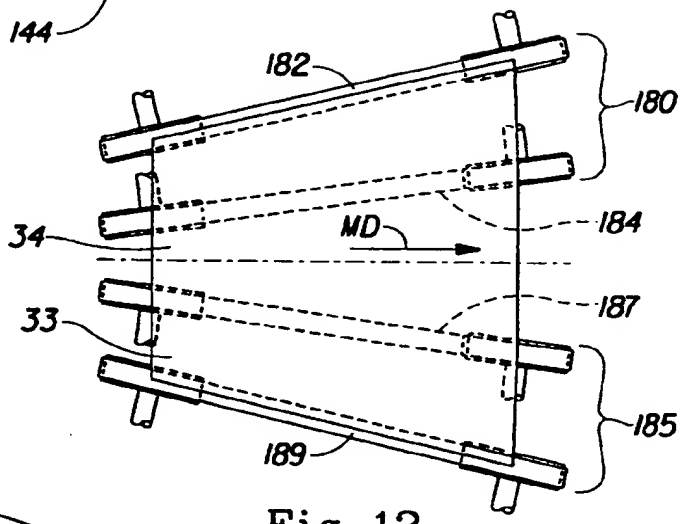


Fig. 12

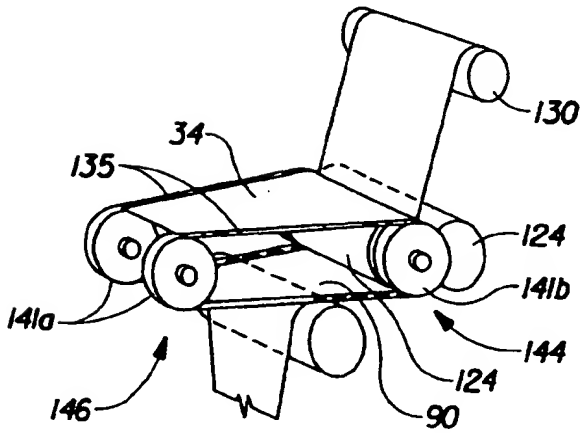
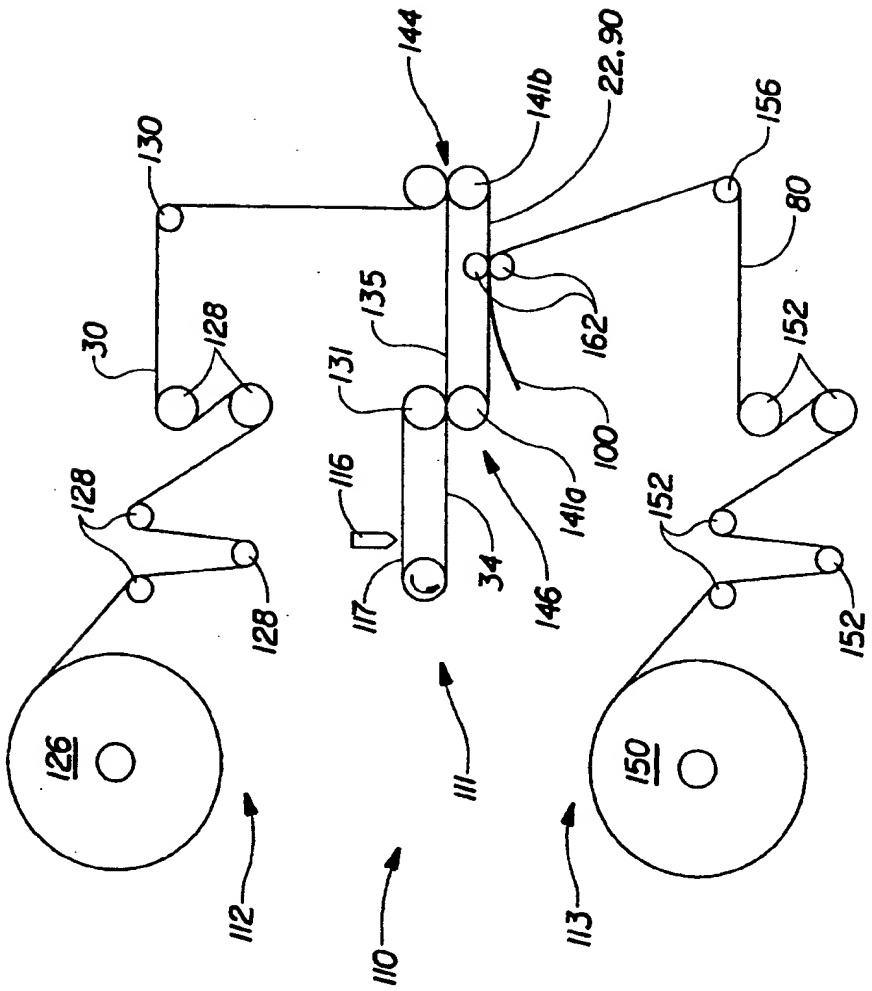


Fig. 13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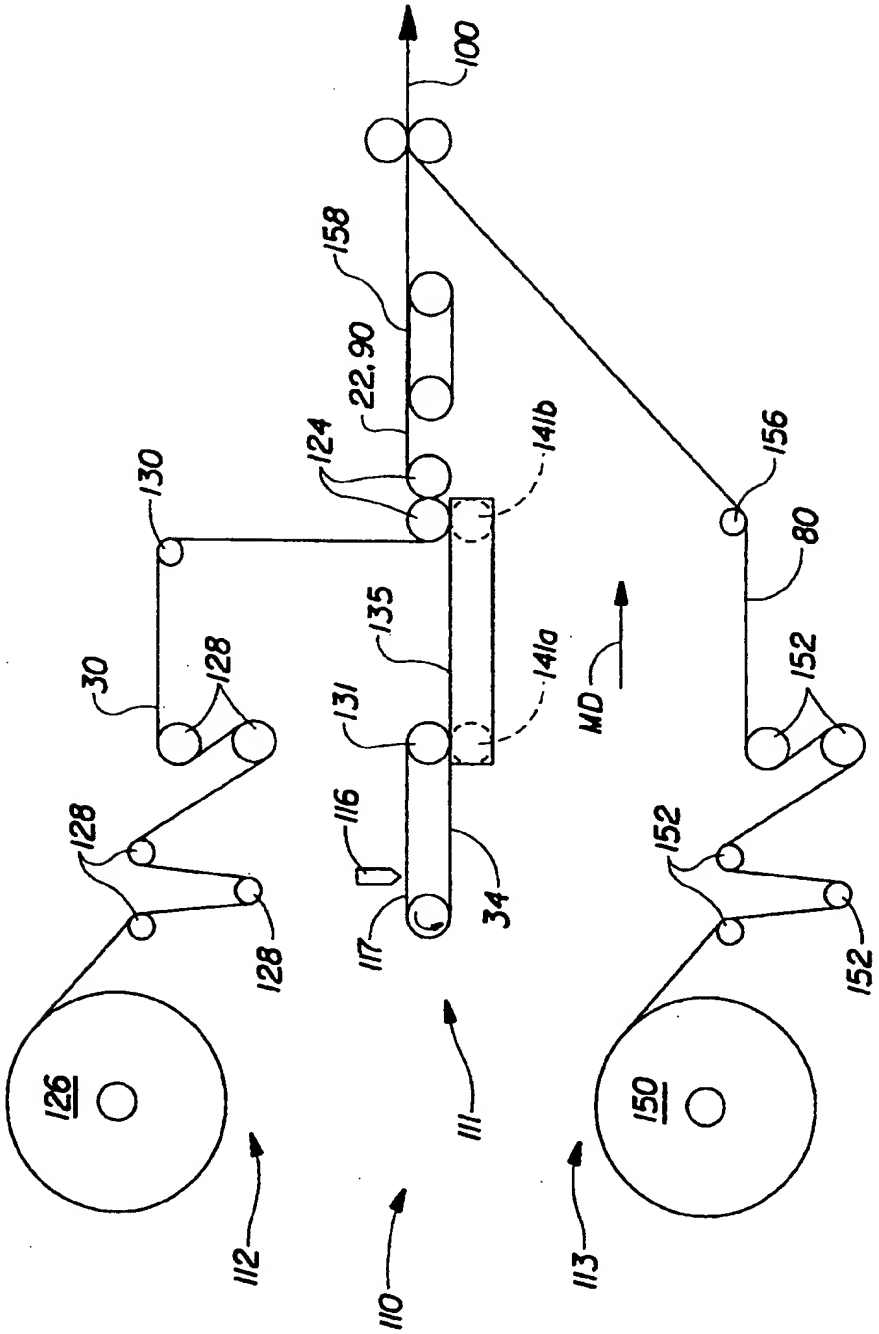
110
113

Fig. 14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112
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113

Fig. 15

NONWOVEN FEMALE COMPONENT FOR REFASTENABLE FASTENING DEVICE AND METHOD OF MAKING THE SAME

This is a division of application Ser. No. 08/254,814, filed on Jun. 6, 1994, now abandoned.

FIELD OF THE INVENTION

The present invention relates to a female component for refastenable hook and loop type fastening devices and, more particularly, to a low-cost female component for a hook and loop type fastening device and a method for producing such a female fastening component.

BACKGROUND OF THE INVENTION

Refastenable fastening devices of the hook and loop type are currently used widely in a great number of situations. Such refastenable fastening devices have been particularly useful in clothing disposable absorbent articles, and the like. Such devices are used when it is desirable to create a refastenable bond between two or more articles or between several surfaces of the same article. In certain applications, these refastenable fastening devices have replaced conventional buckles, zippers, buttons, snaps, tie fasteners, and sewing.

A popular type of mechanical fastener currently in wide use which utilizes mechanical entanglement to create a refastenable bond is sold under the trademark "VELCRO". VELCRO fastening devices are described in greater detail in U.S. Pat. Nos. 2,717,437, 3,009,235, 3,266,113, 3,550,837, 4,169,303, and 4,984,339.

VELCRO fasteners utilize two components. A male component and a female component. The male and female components are often referred to as the hook and loop components, respectively. The male component contains a plurality of resilient, upstanding hook shaped elements. The female component of the fastening device generally consists of a fabric containing a plurality of upstanding loops on its surface. When the male component and the loop component are pressed together in a face to face relationship to close the fastening device, the hooks entangle the loops forming a plurality of mechanical bonds between the individual hooks and loops. When these bonds have been created, the components will not generally disengage under normal conditions. This is because it is very difficult to separate the components by attempting to disengage all the hooks at once. However, when a gradual peeling force is applied to the components, disengagement can he easily effected. Under a peeling force, since the hooks are comprised of a resilient material, they will readily open to release the loops.

This type of fastening device has been found especially useful on disposable articles such as disposable garments, disposable diapers, disposable packages, cartons, and the like. Such fastening devices provide a secure closing means. However, the use of existing fastening devices of this type on disposable articles has been limited due to the fact that such fastening devices are relatively costly. A major reason that such fastening devices are costly is that they have high manufacturing costs. These high manufacturing costs are associated with both the hook and loop components of these devices.

Conventional hook and loop components are typically formed by making a fabric with a number of woven loops extending outwardly from a backing. The loops may be provided by weaving a base fabric containing supplementary

threads to form the loops, or by knitting the loops into a fabric. In other hook and loop components, the loops may be formed by pleating or corrugating processes. The male components of such fastening devices are typically formed by subsequently cutting the loops. The cut loops serve as the hooks of the male component.

These processes generally produce costly hook and loop fastening materials because they are relatively slow. The hook and loop components of such fastening devices are also usually made out of the same relatively expensive material. This material is relatively expensive because the material used in the male component needs to be resilient so that the hooks can disengage from the loop component when the device is open.

Several attempts have been made to make alternative types of female components for fastening devices. However, such attempts have generally suffered from a number of drawbacks.

U.S. Pat. No. 3,694,867 issued to Stumpf on Oct. 3, 1972, discloses a "separable clasp" having a female component that comprises a "high loft" nonwoven fabric and a backing layer of consolidated flexible adhesive. However, the loop component disclosed in the Stumpf patent is prepared by performing the steps of: (1) activating an open pattern adhesive in which the 6hers are imbedded, (2) consolidating the adhesive into a substantially continuous backing layer, and (3) simultaneously looping portions of the fibers such that the fibers form individual loops that extend outwardly from the backing. The female component disclosed in this patent suffers from the drawback that it is made by processes that involves mechanically manipulating fibers in the form of loops. Thus, the female components described therein do not appear to be significantly less expensive to manufacture than conventional loop components.

U.S. Pat. No. 4,761,318 issued to Ott, et al. on Aug. 2, 1988, discloses a loop fastener that can contemporaneously be both formed and also attached to a substrate without the need for any additional steps such as sewing or utilizing pressure sensitive adhesives to affix it to the substrate. However, the Ott loop fastener comprises a fibrous structure having a multiplicity of loops that is adhered to a layer of thermoplastic resin. Thus, the process disclosed in this patent suffers from the drawback that heat must be applied to bond the fibrous structure to the backing.

U.S. Pat. No. 3,708,833 issued to Ribich, et al. on Jan. 9, 1973, discloses a refastenable fastening device having a female component that comprises reticulated urethane foam secured to a backing layer. The female component disclosed in the Ribich, et al. patent suffers from the drawback that foams typically do not have enough openings for the hooks of conventional male components to penetrate. In addition, reticulated foam generally does not have sufficient strength to hold such hooks when forces are applied to the fastening device. Further, manufacturing reticulated foam is a relatively expensive process.

U.S. Pat. No. 5,032,122 issued to Noel, et al. on Jul. 16, 1991, discloses a loop fastening material having a backing of orientable material and a multiplicity of fibrous elements extending from the backing. The fibers are secured to the backing while the backing is in a dimensionally unstable state. The backing is then caused to be transformed to its dimensionally stable state thereby shearing the fibrous elements to form the catching regions of the loop material. Although the Noel patent discloses an acceptable low cost loop fastening material, the search has continued for more economical loop fastening materials and methods for producing such materials.

Thus, it is an object of the present invention to provide an improved fastening device for disposable articles.

It is another object of the present invention to provide an improved female component of a refastenable hook and loop type fastening device.

It is a further object of the present invention to provide a female component for a hook and loop type fastening device which may be formed by positioning a plurality of filaments on an elastomeric adhesive backing without manipulating the fibers into the form of loops to form a low cost loop fastening material.

It is another object of the present invention to provide a female component for a fastening device that can be used with both commercially available male components having resilient individual hooks, as well as less expensive male components with more brittle hooks than those currently in use.

It is a still further object of the present invention to provide a low cost and improved method for producing a female component for a hook and loop type fastening device.

These and other objects of the present invention will be more readily apparent when considered in reference to the following description and when taken in connection with the accompanying drawings.

SUMMARY OF THE INVENTION

The present invention provides a loop fastening material having an elastomeric adhesive backing and a multiplicity of fibrous elements extending from the backing, The fibrous elements are formed by filaments positioned on the backing when the backing is in it elongated orientation. The filaments are preferably positioned on the backing essentially parallel to each other and essentially parallel or perpendicular to the path of response of the backing material. The filaments are preferably intermittently secured to each other at spaced, fixed regions so that the fixed regions define therebetween catching regions. Thus, the fibrous elements are formed by shirring of the filaments at the catching regions when the backing material is returned to its relaxed orientation.

The loop fastening material is formed by a method comprising the steps

(a) providing a first lamina comprising an elastomeric, pressure-sensitive adhesive film having a first adhesive surface and a second adhesive surface opposed to said first adhesive surface, a relaxed orientation and an elongated orientation;

(b) stretching said first lamina from said relaxed orientation to said elongated orientation;

(c) contacting a second lamina comprising a nonwoven web with said first surface of said first lamina in said elongated orientation, thereby directly joining said second lamina and said first lamina to form a laminate; and

(d) relaxing said first lamina such that said second lamina is shirred to form catching regions capable of entangling the hooks of a complementary male fastening component.

The present invention also relates to a fastening device having a hook fastening material and a loop fastening material. The loop fastening material comprises the improved loop fastening material of the present invention. The hook fastening material comprises any of the well known hook fastening materials as are known in the art and which have a base and a number of engaging elements extending from the base. The loop fastening material and the complimentary hook fastening material provide a secure closing means that will resist shear stress and peel forces encountered during use. The present invention also relates to disposable articles and more particularly to a disposable diaper having such an improved fastening device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the filaments and the backing used to form the present invention prior to the filaments being positioned or laid down on the backing.

FIG. 2 is a perspective view of the female component of the present invention when the backing is in its elongated orientation.

FIG. 3 is a perspective view or the female component or the present invention when the backing is in its relaxed orientation.

FIG. 4 is a perspective view of a fastening device according to the present invention.

FIG. 5 is a greatly enlarged side view of the fibrous elements of the female component of the present invention.

FIG. 6 is a greatly enlarged side view of an alternative tri-laminate embodiment of the present invention.

FIG. 7 is a perspective view of a disposable diaper that includes the fastening device of the present invention.

FIG. 8 is a perspective view of a disposable diaper that includes the fastening device of the present invention.

FIG. 9 is a schematic side view of a process for making the female component of the present invention.

FIG. 10 is a schematic top view of a part of the process for making the female component of the present invention.

FIG. 11 is a schematic top view of an alternative embodiment of the process for making the female component of the present invention.

FIG. 12 is a schematic top view of an alternative embodiment of the process for making the female component of the present invention.

FIG. 13 is an isometric view of a part of the process for making the female component of the present invention.

FIG. 14 is a schematic side view of one embodiment of the process for making the tri-laminate embodiment of the present invention.

FIG. 15 is a schematic side view of an alternative embodiment of the process for making the tri-laminate embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Overall Characteristics of the Refastenable Fastening Device

A preferred embodiment of the refastenable fastening device of the present invention, fastening device **20**, is shown in FIG. **4**. The fastening device **20** comprises a nonwoven female component **22** and a complementary hook fastening component **24**.

The female portion of the device, more specifically, the nonwoven female component (or simply "female component") **22** receives and engages the hooks **28** of the male component. The female component **22** shown in FIGS. **3** and **4** comprises at least one nonwoven web **30** secured to a backing **34**. As shown in FIG. **1**, the nonwoven web **30** has an outwardly-facing surface **21** and an inwardly-facing surface **23** opposed to the outwardly-facing surface **21**. The

nonwoven web **30** comprises a plurality of filaments (or fibers) **36** that entangle the hooks **28** of the male component **24**. The backing has a first surface **31** and a second surface **33** opposed to the first surface **31**, and preferably comprises an elastomeric adhesive.

The male portion of the device, more specifically, the hook fastening component (or simply "hook component") **24**, comprises a base **26** having a first surface **27** and a second surface **29**. The base **26** comprises a plurality or upstanding engaging elements, or "hooks" **28**, extending from the first surface **27**. The term "hook" is nonlimiting in the sense that the engaging elements may be in any shape known in the art so long as they are adapted to engage a complimentary loop fastening component or the female component **22** of the present invention. The hooks **28** generally have heads **38** (or engaging means) which are disposed on top of the shanks, or stems **40**, that extend from the first surface **27** of the male component **24**.

The fastening device **20** of the present invention functions in the following manner. The fastening device **20** is closed when the female component **22** and the male component **24** are pressed face-to-face against each other. When this happens, the hooks **28** are entangled by the fibers **36** of the nonwoven web **30**. The nonwoven web **30** provides space for the hooks, particularly, the heads **38** of the hooks to occupy when the fastening device **20** is closed. The backing **34** provides a supporting foundation for the nonwoven web **30**. With the hooks **28** mechanically entangled by, or "hooked", onto the fibers **36** (shown in the portion of the fastening device **20** to the right side in FIG. **4**), the connection between the components resists the forces that may be exerted on the fastening device **20**.

The fastening device **20** is opened by peeling the male component **24** away from the female component **22** (or by peeling the female component **22** away from the male component **24**). If the male component **24** has resilient hooks, the peeling action may cause the hooks to be bent so that they are disengaged from entanglement with the fibers **36** of the nonwoven web **30**. In other cases (particularly if the hooks **28** are relatively inflexible), the hooks **28** may be separated by breaking the fibers **36** of the female component **22**. In either case, the hooks **28** are disengaged and the male component **24** is completely detached from the female component **22**. The fastening device **20** is then capable of being refastened in the manner described above.

Female Fastening Component

The term "nonwoven female component", as used herein refers to a female component for a refastenable fastening device that comprises a nonwoven web joined to a backing. (The nonwoven female component may also be referred to as a loop fastening material or imply, a loop fastener.) The term "nonwoven web" refers to fabrics made of fibers held together by interlocking or inter-fiber bonding which are not woven, knitted, felted, or the like. However, the nonwoven web referred to herein may comprise fibers that are initially substantially unbonded which are subsequently bonded to each other.

FIG. **1** shows the backing **34** and the nonwoven web **30** used to form the female component **22** prior to their association. The backing **34**, preferably an elastomeric adhesive, is shown in its elongated orientation (stretched in a direction parallel to the line designated A—A). As used herein, the term "elastomeric" refers to materials that extend in at least one direction when a force is applied and return to approximately their original dimensions after the force is released. The nonwoven web **30**, as shown in FIG. **1**, preferably comprises a multiplicity of filaments **36** that are joined with each other by inter-fiber bonds **32** prior to being associated with the backing **34**. As used herein, the term "joined" encompasses configurations whereby an element is directly secured to another element and configurations whereby an element is indirectly secured to another element by affixing an element to intermediate member(s) which in turn are affixed to another element. The term "inter-fiber bonds" refers to bonds that join one or more filaments to one or more other filaments.

FIG. **2** shows a preferred embodiment of the female component **22** where the backing **34** is in its elongated orientation after the nonwoven web **30** has been positioned on and joined to the first surface **31** of the backing **34**. Preferably, the filaments **36** of the nonwoven web **30** are aligned essentially parallel to each other and essentially perpendicular to the path of response of the backing **34**. ("Essentially perpendicular" is used herein to indicate that the filaments **36** need not extend absolutely perpendicular to the path of response so long as the majority of the filaments **36** extend perpendicularly to or a small deviation off perpendicularly to the path of response. As used herein, the term "path of response" refers to the direction in which an elastomeric material in an elongated orientation will respond when the forces acting to elongate the elastomeric material are removed. Further, the filaments **36** of the nonwoven web **30** are preferably in an untensioned state when they are joined to the elongated backing **34**.) This helps to ensure that the filaments **36** will become "shirred" when the backing **34** contracts to its relaxed orientation (shown in FIG. **3**). The term "shirred" as used herein, refers to the gathering of the filaments **35** of the nonwoven web **30** caused by the contraction of the backing **34** from its elongated orientation to its relaxed orientation such that portions of the filaments **36** that are not secured to the backing **34** or other filaments **36** bend away from the first surface **31** of the backing **34**. The shirred filaments **36** form unsecured catching regions **37** (loops) capable of entangling the hooks **28** of a complementary male fastening component **24**.

FIG. **3** shows a preferred embodiment of the present invention after the nonwoven web **30** and the backing **34** have been joined and after the forces acting to elongate the backing **34** have been removed such that the backing **34** has contracted to its relaxed orientation. The shirred filaments **36** form a multiplicity of fibrous elements **35** extending outwardly from the first surface **31** of the backing **34**. Each of the fibrous elements **35** comprises a pair of fixed regions **42** (joined to the backing **34**) and an unsecured catching region **37** disposed between the pair of fixed regions **42**. The catching regions **37** are capable of securely engaging the hooks of a complementary hook fastening component to provide a fastening device **20**, as is shown in FIG. **4**.

1. The Nonwoven Web

The fibrous elements **35** of the present invention are preferably formed from filaments **36** positioned on and secured to the backing **34**. As used herein, the term "filament" defines a member having a high ratio of length to diameter or width. (FIG. **5** shows a portion of the female fastening component **22** greatly enlarged to show the filaments **36** in detail.) Thus, a filament may be a fiber, a thread, a strand, a yarn or any other member or combination of these members, including filaments that are preattached together in nonwoven webs, as are known in the art. Suitable materials for such filaments **36** include natural fibers such as cotton or wool; synthetic fibers of nylon, polyamides, polyesters, or polyolefins; spun yarns; polyethylene fibers; polypropylene fibers; nylon fibers, non-woven webs; or any other material or combination of materials known in the art and suitable for use herein.

The filaments **36** may be manufactured using a number of manufacturing techniques including those such that the filaments are spun, blown, or the like. Preferably, each filament **36** comprises a polypropylene fibers of between about 2 and about 15 denier. The individual filaments **36** are preferably comprised in a nonwoven web **30** having a basis weight of between about 10 g/yd2 and about 40 g/yd2 (about 12 g/m2 to about 48 g/m2), more preferably between about 15 g/yd2 and about 25 g/yd2 (about 18 g/m2 and about 30 g/m2). The nonwoven web **30** may comprise filaments **36** having similar or different deniers and lengths. Further, the nonwoven web **30** may comprise a mixture of filaments **36** comprising different materials. Some nonwoven webs comprising suitable filaments include the carded polypropylene nonwoven web manufactured by the Veratec Nonwoven Group of the International Paper Company, of Walpole, Mass. under the trade name P-**11**, the spunbonded polypropylene nonwoven web P-**9**, and the carded polypropylene nonwoven web P-**8**. Other suitable nonwoven webs comprising suitable filaments include COP-OVON spunbonded polypropylene manufactured by Cotoran GmbH of Germany, and CELESTRA manufactured by the James River Corporation.

The lengths of the filaments **36** in the nonwoven web **30** depend upon the type of process used to make the nonwoven web **30**. For instance, if a carded nonwoven web is used, the filaments **36** that comprise such a web can have lengths that range from about 0.5 inches to about 5 inches (from about 1 cm. to about 13 cm.). In preferred carded nonwoven webs, the filaments are between about 1 inch and about 3 inches (between about 2.5 cm. and about 8 cm.) long. Alternatively, if a spunbonded nonwoven web is used, the filaments **36** of such a web will typically be continuous length. (As used herein, the term "continuous" refers to relatively long filaments that run the entire length of the nonwoven web.)

A preferred filament **36** has a length to make at least one complete fibrous element **35**. Thus, for example, the filament **36** may only have a pair of fixed regions **42** positioned adjacent its ends so that the fibrous element **35** is formed of a whole filament **36**. More preferably, the filament **36** has a number of fixed regions **42** positioned along its length to form a plurality of fibrous elements **35** along each filament **36**. If the filaments **36** are short, or staple, complete fibrous elements **35** having two fixed regions **42** and catching regions **37** may not be formed. The resulting incomplete fibrous elements **35** may not be able to securely engage the hooks **28** of a complementary hook fastening material **24**. Thus, the ability of the nonwoven female component **22** to provide a secure closure may be diminished.

The amount of inter-fiber bonding between the filaments **36** of the nonwoven web **30** is also an important factor relevant to the ability of the female component **22** of the present invention to entangle the complementary hook fastening component **24**. An excessive number of bond sites created between the filaments **36** in the nonwoven web **30** will tend to interfere with the entry of hooks **28** into the nonwoven web **30**, thus reducing the shear strength of the fastening device. On general, the strength of the fastening device will be increased as more hooks are able to enter and engage the nonwoven web.) Alternatively, too few inter-fiber bonds **32** may increase the number of filaments **36** having loose (unbonded) ends, thus reducing the female component's **22** ability to entangle the hooks **28** of the complementary hook fastening component **24**.

In a preferred embodiment of the present invention, the total plan view area of the inter-fiber bonds **32** is between about 1 percent and about 35 percent of the total area of the nonwoven web **30**. More particularly, the total plan view area of the inter-fiber bonds is between about 5 percent and about 25 percent of the total area of the nonwoven web. The percentage of inter-fiber bonding is preferably measured by examining a representative sample of the nonwoven web under a microscope. The sample is viewed from directly above the outwardly-facing surface **21** of the nonwoven web **30**. The plan view area of each inter-fiber bond **32** is measured. The sum of the areas of the bonds is divided by the area of the sample. The result is the percentage area occupied by the inter-fiber bonds.

The pattern of the inter-fiber bonds within the nonwoven web is another important factor relating to the strength and overall efficacy of the female component. The inter-fiber bonds **32** may be continuous lines or intermittent areas of bonding. Preferably, the inter-fiber bonds **32** are sufficiently close together that the filaments **36** of the nonwoven web **30** have relatively few unbonded loose ends. Thus, the distance between inter-fiber bonds **32** is preferably less than the average length of the filaments **36** in the nonwoven web **30**, more preferably, less than about one-half the average length of the filaments **36** in the nonwoven web **30**.

In a preferred embodiment of the present invention, the inter-fiber bonds **32** are arranged in a regular pattern. As used herein, the term "regular" refers to bond patterns that are generally similar throughout the area of the nonwoven web **30** when viewed from directly above the outwardly-facing surface **21** of the nonwoven web **30**. Suitable inter-fiber bonding patterns include a series of straight or curved lines, or arrangements of inter-fiber bonds **32** that form grids defining different geometrical shapes such as squares, rectangles, hexagons, diamonds, and circles. Such regular patterns will provide the female component **22** with relatively uniform holding characteristics.

One bonding pattern that has been found to work especially well in the female component **22** of the present invention is the intermittent diamond-shaped pattern shown in FIGS. **1** and **2**. The "diamonds" in the diamond-shaped pattern comprise a number of intermittent inter-fiber bonds **32** regularly arranged in lines that define the edges of generally square shaped regions. (A preferred arrangement of the inter-fiber bonds **32** of the nonwoven web **30** before the filaments **36** become shirred is shown on the left side of FIG. **2**. A preferred arrangement of the inter-fiber bonds **32** of the nonwoven web **30** after the filaments **36** have become shirred is shown on the left side of FIG. 4.). The pattern is rotated approximately 45 degrees to give the appearance of diamonds. Preferably, the dimensions of the pattern should be such that the distance between the inter-fiber bonds **32**, in at least some portion of the area between the sides of the diamond-shaped areas, is greater than the projected plan view dimensions of the hooks **28** of the complementary male component **24**. (Plan view dimensions of complementary male components are discussed in greater detail below.) Nonlimiting examples of diamond-shaped bonding patterns suitable for use in female component **22** of the present invention include patterns having sides that measure between about ½ inch×½ inch (about 1.3 cm.×1.3 cm.) and about ⅛ in×⅛ in. (about 0.3 cm.×0.3 cm.), more preferably between about ¼ inch×¼ inch (about 0.6 cm.×0.6 cm.) and about ⅜ inch×⅜ inch (about 1 cm.×1 cm.), and most preferably about ¼ inch×¼ inch (about 0.6 cm.×0.6 cm.). A suitable nonwoven web **30** comprising inter-fiber bonds **32** arranged in a diamond-shaped pattern is available from the Veratec Nonwoven Group of the International Paper Company, of Walpole, Mass. under the trade name P-**11**.

The inter-fiber bonds **32** may be produced by any method that is known in the art. In a preferred embodiment, the

inter-fiber bonds **32** are produced by passing a nonwoven web **30** through a pair of rollers that have been heated close to the melting point of the filaments **36** comprised in the nonwoven web **30**. One of the rollers preferably has a smooth surface; the complementary roller has a pattern of pins extending from its surface in the diamond-shaped pattern described above. When the nonwoven web **30** passes between the rollers, the heat and pressure of the rollers causes distinct regions of the filaments **36** to melt producing inter-fiber bonds **32** in the preferred diamond-shaped pattern.

The nonwoven web **30** is preferably positioned on and joined with the backing **34** while the backing **34** is in an elongated orientation and while the filaments **36** are in an untensioned condition. While the filaments **36** could conceivably be positioned on the backing **34** in a tensioned or unstable state, such is not preferred to provide maximum shirring of the filaments **36**. Further, while the backing **34** could be in a relaxed orientation when the filaments **36** are positioned on the backing **34**, this is not preferred because in causing the backing **34** to become elongated, enough filaments **36** may be dislocated, disarranged, skewed or bonded to the backing **34** such that the fibrous elements **35** would not be as effective in engaging the hook fastening component.

The configuration in which the filaments **36** are positioned or laid down on the backing **34** determines the size and the ability of the loop fastening component **22** to provide an effective fastening device. While the filaments **36** may be randomly positioned on the backing **34** such that the filaments **36** overlap or extend in many different directions, it has been found that the filaments **36** should preferably be positioned as parallel with each other as possible to provide fibrous elements **35** configured in a uniform direction. In addition, while the filaments **36** may be positioned lengthwise on the backing **34** in any direction, in order to take advantage of the maximum shirting effect of the backing **34** to form fibrous elements **35** of maximum height, the filaments **36** are preferably positioned on the backing **34** in a direction essentially perpendicular to the path of response of the backing **34**. (It has been found, however, that filaments **36** positioned essentially parallel to the path of response also provide suitable entangling ability.) The filaments **36** may be positioned or laid down on the backing **34** by any method or means that is known in the art.

2. The Backing

The backing **34** of the present invention is that part of the female fastening component **22** to which the nonwoven web **30** is secured. The backing **34** is preferably comprised of an elastomeric, pressure sensitive adhesive, so that it may be readily joined to the nonwoven web **30** to form the nonwoven female component **22**. As used herein, the term "elastomeric" refers to materials that extend in at least one direction when a force is applied and return to approximately their original dimensions after the force is removed. Thus, elastomeric materials have an elongated orientation (when force is applied) and a relaxed orientation (when force removed). The term "adhesive" refers to materials which are capable of bonding to another material by sticking, or adhering, to the surface of the other material. A "pressure sensitive adhesive" is an adhesive that is responsive to pressure, i.e., is capable of adhering under the influence of pressure alone.

The elastomeric adhesive comprising the backing **34** of the present invention may take on a number of different configurations. For example, the backing **34** may comprise a thin film having a uniform or varying thickness, slits, holes, deformations or the like; a laminate of two or more films; a web of elastomeric adhesive; a single or multiple strands of elastomeric adhesive; discrete regions of elastomeric adhesive formed in random or regular patterns; or any combination of the above. In one preferred embodiment, the backing **34** comprises an elastomeric adhesive that has been extruded in the form of a thin film of about 0.03 mm. to about 1.0 mm. (about 0.001 in. to about 0.04 in.). In a particularly preferred embodiment, the elastomeric film has a thickness of between about 0.025 mm. to about 0.38 mm (about 0.001 in. to about 0.015 in.).

The elastomeric adhesive selected for the backing **34** may comprise any of a number of different elastomeric adhesives as are known in the art. The elastomeric adhesive preferably has an elastic modulus between about 1 and about 30 PSI and more preferably between about 5 and about 15 PSI. (The elastic modulus calculation is preferably determined on the strain interval of about 50% to about 150% elongation of any convenient gage length using the original cross sectional area of the sample prior to straining the sample to determine the elastic modulus.) Further, the elastomeric adhesive should be capable of elongation from about 500 to about 1000 percent in at least one direction without rupture. More preferably, the elastomeric adhesive should be capable of between about 500 percent and about 1000 percent elongation without rupture, not exhibit excessive necking or thinning when elongated, or exhibit excessive hysteresis or delamination upon elongation.

Other characteristics that help define suitable elastomeric adhesives relate to the process in which the present invention is made. As described below, the elastomeric adhesive preferably forms a film that is stretched prior to the application of the nonwoven to the elastomeric adhesive backing. One preferred method of inducing the stretch is to adhere a portion of the elastomeric adhesive film to tentering belts that diverge to stretch the film. The overlap between the film and the tentering belts forms a "lap joint", (The term "diverge" is used herein to mean move apart. The term "lap joint" refers to the area where two overlapping materials are joined together.) Preferably, the tensile strength of the film should be less than the lap shear bond strength between the film and the tentering belts. (As used herein, the term "tensile strength" refers to the pulling stress required to break a given specimen. The term "lap shear bond strength" refers to the force needed to disrupt a lap joint, wherein the force applied is essentially parallel to the surface which adjoins the elastomeric adhesive film and the tentering belts.) Thus, as the tentering belts diverge and stretch the film, the bond between the film and the tentering belts remains in

A pressure sensitive elastomeric adhesive marketed by the Findley Adhesive Corporation of Wauwatoss, Wis. under the trade name 198–338, has been found to be particularly well suited for this purpose. However, other suitable elastomeric materials include H2206 and HS2206, each of which is available from the Findley Adhesive Corporation.

Alternative Embodiments

FIG. **6** shows an alternative embodiment of the female component **22** of the present invention comprising a second lamina **80** joined to the second surface **33** of the elastomeric adhesive backing **34** to form a tri-laminate **85**. Joining a second lamina **80** to the elastomeric adhesive backing **34** provides the female fastening component with additional advantages. For instance, the tri-laminate material **85** may be incorporated into a disposable absorbent article, such as a diaper as an elastomeric waistband capable of engaging the hooks of a complementary male fastening component. Fur-

ther, the tri-laminate S5 provides an elastomeric female fastening component 22 capable of engaging the hooks 28 of a complementary male fastening component 24 on two opposing surfaces.

In an especially preferred alternative embodiment of the present invention, the second lamina 80 comprises a nonwoven web such as the nonwoven web 30 described above with respect to the female fastening component 22. However, a suitable lamina may be manufactured from a wide range of materials, including plastic films; woven webs of natural fibers (e.g. wood or cotton), synthetic fibers (e.g. polyester or polypropylene), or a combination of natural and synthetic fibers; foams; or natural or synthetic rubber.

The second lamina 80 may be joined to the elastomeric adhesive backing 34 in the manner described with respect to the nonwoven web 30 or any other method as is known in the art. Further, the second lamina 80 may be joined to the backing 34 contemporaneously with the nonwoven web 30 when the backing 34 is in an elongated orientation or at any other time after the adhesive backing 34 is formed. In a preferred embodiment, however, the lamina 80 is joined to the backing 34 after the nonwoven web 30 has been joined to the backing 34 and after the backing 34 has been at least partially relaxed. (An elastomeric material in an elongated orientation is partially relaxed when the forces stretching the elastomeric material are reduced, allowing the material to contract but not completely relax. Thus, an elastomeric material in a partially relaxed condition is still capable of contracting further to its relaxed orientation after the forces are completely removed.) Joining the second lamina 80 after the backing 34 has been at least partially relaxed ensures that the fibrous elements 35 of the nonwoven web 30 will remain shirred when the female fastening component 22 is stretched. This is because the second lamina 80 will become fully extended to its elastic limit before the nonwoven web 30, thus maintaining at least some shirring in the filaments 36 of the nonwoven web 30. Thus, an elastomeric nonwoven female component 22 is provided that will maintain its ability to entangle the hooks 28 of a complementary male fastening component 24 even after the female component 22 has been stretched to a point where the second lamina 80 is fully extended. (If the second lamina 80 is joined to the backing 34 when the backing 34 is in its fully relaxed orientation, the female component 22 will lose its elastomeric qualities. Thus, such an embodiment is not preferred where the female component must be capable of stretching.)

The Complementary Male Component

The term "male component", as used herein, is used to designate the portion of the fastening device 20 having engaging elements, such as hooks 28. The male components 24 used with the nonwoven female component 22 of the present invention can be conventional, commercially available hook materials. The male component 24, however, is not limited to conventional materials with flexible, resilient hooks 28. Suitable male components can have less expensive, relatively inflexible, more brittle hooks. Further, the engaging elements may have any shape knob in the art such as hooks, "T's", mushrooms, or any other shape. One suitable male component 24 may comprise a number of shaped engaging elements projecting from a woven backing such as the commercially available material designated "SCOTCHMATE" brand No. FJ3402 available from Minnesota Mining and Manufacturing Company, St. Paul, Minn. A preferred male component is described in U.S. Pat. No. 4,846,815 entitled "Disposable Diaper Having An Improved Fastening Device" which issued to C. L. Scripps on Jul. 11, 1989. Other particularly preferred male components and methods for making the same are the prongs described in U.S. Pat. No. 5,058,247 entitled "Mechanical Fastening Prong" issued to Thomas et al. on Oct. 22, 1991; U.S. Pat. No. 5,116,563 entitled "Process for Producing a Mechanical Fastener" issued to Thomas et al. on May 26, 1992; U.S. Pat. No. 5,180,534 entitled "Process of Manufacturing A Refastenable Mechanical Fastening System", which issued to Thomas, et al. on Jan. 19, 1993; and U.S. Pat. No. 5,230,851 entitled "Process of Manufacturing a Refastenable Fastening System" issued to Thomas on Jul. 27, 1993. Each of these patents are hereby incorporated by reference herein.

The male component 24 may be manufactured from a wide range of materials. Such suitable materials include, but are not limited to, nylon, polyester, polypropylene, or any combination of these or other materials.

Examples Of Uses Of The Refastenable Fastening Device

The refastenable fastening device of the present invention is especially useful as a fastening device for disposable absorbent articles. The term "disposable absorbent article", as used herein, refers to articles which absorb and contain body exudates. More particularly, the term refers to articles which are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body. The term "disposable" means that such articles are intended to be discarded after a single use (i.e., they are not intended to be laundered or otherwise be used). Examples of disposable absorbent articles include diapers, incontinence garments, sanitary napkins, bandages, and the like.

FIGS. 7 and 8 show an exemplary disposable diaper 50 comprising a fastening system 72 including the nonwoven female fastening component 22 of the present invention. The diaper 50 preferably comprises a body portion 51 and two waist regions, a first waist region 56, and a second waist region 58. The body portion 51 preferably comprises a liquid previous topsheet 64, a liquid impervious backsheet 68, and an absorbent core 66.

As shown in FIG. 7, the fastening system 72 of the diaper 50 comprises the female fastening component 22 of the present invention, among other elements. The fastening system 72 may take on a number of configurations and constructions. In one preferred embodiment, the first fastening element 72*a* comprises a male component 24. The male component 24 provides hooks 28 that extend from the tab 74 disposed in the second waist region 58. The nonwoven female component 22 of the present invention comprises the second fastening element 72*b* disposed in the first waist region 56. However, the positions of the components of the fastening device 20 of the present invention could be reversed so that the first fastening element 72*a* comprises the nonwoven female component 22 and the second fastening element 72*b* comprises the male component 24.

In an especially preferred embodiment of the disposable diaper 50, the filaments 36 in the nonwoven web 30 of the female component 22 are aligned in a single direction. The female component 22 is oriented so that the filaments 36 in the nonwoven web 30 extend essentially parallel to the longitudinal edges 60 of the diaper 50. This orientation aligns the filaments 36 generally perpendicular to the direction of shear forces applied to the fastening device 20 during use. In this configuration the filaments 36 provide the maximum peel and shear force resistance.

Several examples of well known diaper configurations to which the present invention can be readily adapted are described in U.S. Pat Nos. 5,151,092 and 5,221,274 both entitled "Absorbent Article With Dynamic Elastic Waist Feature Having A Predisposed Flexural Hinge", issued to

Kenneth B. Buell, et al. on Sept. 29, 1992 and Jun. 22, 1993, respectively; co-pending U.S. patent application Ser. No. 08/155,048 entitled "Absorbent Article With Multi-Directional Extensible Side Panels", filed Nov. 19, 1993; and co-pending U.S. patent application Ser. No. 08/203,456 entitled "Absorbent Article With Multiple Zone Structural Elastic-Like Film Web Extensible Waist Feature" filed on Feb. 28, 1994. Each of the above mentioned patents and co-pending patent applications are hereby incorporated by reference herein. It should be understood, however, that the fastening device of the present invention is not limited to use with any specific diaper structure or configuration.

The female fastening component **22** of the present invention may also be used to provide an inexpensive waistband, or any other elastomeric element (or a portion thereof) of an absorbent article, capable of engaging the hooks **28** of a complementary male fastening component **24**. (As used herein, the term "waistband" refers to that portion of an absorbent article that partially or wholly encircles the waist of the wearer.) FIG. **8** shows a diaper **50** having a waistband **62** comprising the female fastening component **22** of the present invention. Further examples of diapers suitable for use with the present invention ere described in U.S. Pat. No. 4,699,622 entitled "Disposable Diaper Having An Improved Side Closure" which issued to J. W. Toussant, et al. on Oct. 13, 1987; U.S. Pat. No. 5,019,065 entitled "Disposable Absorbent Article With Combination Mechanical and Adhesive Tape Fastener System", issued to Scripps on May 28, 1991; and U.S. Pat. No. 5,242,436 entitled "Absorbent Article With Fastening System Providing Dynamic Elasticized Waistband Fit", issued to Well et al., on Sep. 7, 1993; each of which is hereby incorporated by reference herein.

Method of Making the Female Fastening Component

The female fastening component **22** of the present invention is made by contacting a nonwoven web comprising inter-fiber bonds with an elastomeric, pressure sensitive adhesive film. The adhesive film is formed and elongated in at least the cross machine direction before it is brought in contact with the nonwoven web. When the adhesive film and the nonwoven web are brought into contact with each other, they are joined to form a laminate comprising the nonwoven web and an elastomeric adhesive backing. The laminate is then contracted such that regions of the nonwoven web become shirred and thus, are capable of entangling the hooks of a complementary male fastening component.

The following is a detailed description of the process for making the female fastening component **22** of the present invention. Although the description refers to the elastomeric adhesive backing as an "adhesive film", this terminology should not be construed to limit the scope of the invention. As mentioned above, the adhesive backing **34** may take on a number of different configurations including films, laminates, webs, strands, or the like.

The female component **22** of the present invention may be produced on the illustrated apparatus **110**, as shown in FIG. **9**. The apparatus **110** comprises two separate process modules, process module **111** for the elastomeric adhesive backing **34** (or "adhesive film"), and process module **112** for the nonwoven web **30**. The process module **111** comprises an extrusion head **116** and a release surface upon which the extruded adhesive is formed, such as the forming belt **117**, to Form the elastomeric adhesive backing film **34**. (In an alternative embodiment, the elastomeric adhesive backing could be preformed and supplied to the line from a roll. This would eliminate the extrusion head **116** and the forming belt **117**.)

Examining process module **111** in greater detail, the extrusion head **116** has a slot through which the molten elastic adhesive of the adhesive film **34** is extruded to form a thin film of about 0.03 to about 1.0 millimeters (about 0.001 in. to about 0.04 in.) in thickness, and of any desired width, onto the forming belt **117**. An adhesive film **34** having a thickness of about 0.025 to about 0.38 millimeters (0.001–0.015 inches) is particularly preferred. Generally a thicker adhesive film **34** is preferred as the thickness and stiffness of the nonwoven web **30** increases. It will be apparent to one skilled in the art that increasing the thickness of the adhesive film **34** will generally provide a proportional increase in the ultimate strength of the female fastening component **22**. An adhesive film **34** of about 11.4 g/cm2 has been found to be suitable.

The extrusion head **116** extrudes the molten adhesive onto the forming belt **117** which cools the molten adhesive into an adhesive film **34** suitable for processing and transports the adhesive film **34** to the tentering belts **135**. A roll may be utilized in conjunction with the belt **117** to provide additional cooling and a nip for compression of the adhesive film **34**. Further, the adhesive film **34** may be separated from the forming belt **117** by a doctor blade (not shown).

After being removed from the forming belt **117**, the application roll **131** guides spaced apart regions of the adhesive film **34** onto the surface of the tentering belts **135**. (As used herein, the term "spaced apart" refers to regions of the adhesive film **34** that are spaced apart in the cross machine direction form each other.) The adhesive nature of the adhesive film **34** permits the adhesive film **34** to be secured to the tentering belts **135** without any additional securement means, as are generally used in the art. Preferably, only about ¼ inch to about ¾ inch of the edges of the adhesive film **34** should be secured to the working surface of each tentering belt **135**. (It should be noted, however, that the tentering belts could be designed such that a vacuum assists in holding the film in contact with the tenterlag belts.) The spaced apart regions of the adhesive film **34** are adhered to the working surfaces of the tentering belts **135** forming continuous lap joints. (As used herein, the term "continuous" means relatively unbroken or without interruption.) The continuous nature of the lap joint helps to ensure that the adhesive film **34** will be more evenly stretched than films that are elongated by stretching means comprising discrete mechanical clamping devices.

The tenterlag belts **135** are spaced apart in the cross machine direction and diverge as they move in the machine direction. The tentering belts **135** preferably comprise a substantially flat working surface to which the adhesive film **34** is adhered, and members that help provide positive control of the belts in both the machine and the cross machine directions. The working surface of each tentering belt **135** is preferably comprised of any material, such as TEFLON, to which the adhesive film **34** will adhere sufficiently in shear to stretch the adhesive film **34**, and from which the adhesive film **34** can peeled off without damaging the adhesive film **34** when it is removed. One belt with a suitable working surface is available from F. M. Sheppard & Co, of Erlanger, Ky., and is sold as Belt Style No. 3W11-2A.

Each tentering belt **135** travels about a pair of pulleys. As shown in FIG. **13**, belts **140** and **142** travel about pulleys **141*a*** and **141 *b***. Pulley **141*a*** defines the converging end **146** of the belts **140** and **142** while pulley **141*b*** defines the diverging end **144** of the belts. In one preferred embodiment, the pulleys **141*a*** and **141*b*** comprise V shaped grooves and the tentering belts **140** and **142** comprise V shaped extensions that ride in the complementary V shaped grooves of the pulleys **141*a*** and **141*b***, to provide machine direction control of the belt in the cross machine direction.

The tentering belts **135** may be driven by any driving means well known in the art and are preferably not driven by the adhesive film **34**. In one preferred embodiment, each tentering belt **135** comprises teeth and grooves that coact with the complementary driving means to provide cross machine directional control of the belt as it is driven forwardly.

One embodiment of the present invention, as shown in FIG. **10**, comprises two tentering belts **135**, a first belt **140** and a second belt **142**. A first region **159** of the second surface **33** of the adhesive film **34** is adhered to the first belt **140**, and a second region **160** of the second surface **33** of the adhesive film **34** is adhered to the second belt **142**. The first belt **140** and the second belt **142** diverge as they move in the machine direction, stretching the adhesive film **34** in the cross machine direction. (The cross machine direction is denoted by the arrow C in FIG. **10**.) This configuration is preferred when it is desired that the adhesive film **34** be evenly stretched. (Alternative embodiments comprising more than two tentering belts are discussed below.)

As shown in FIG. **9**, the nonwoven web **30** is taken from the unwind roll **126** and preferably passes through the S-wrap tensioning roll **128** to provide for proper tensioning and to prevent puckering or bunching of the nonwoven web **30**. Guide roll **130** guides the nonwoven web **30** into the nip between the combining rolls **124**. If necessary, a tracking system (not shown) as is commonly utilized and known in the art, may be employed in the process module **112** to optimally track and adjust the webs of nonwoven web **30** into the nip between the combining rolls **124**. A tracking system manufactured by the Fife Corpotation of Oklahoma City, Okla., and sold as Model Op6 LRA may be suitable.

The nip between the combining rolls **124** compresses the nonwoven web **30** into superposing contacting relationship with the elastomeric adhesive backing **34**, causing the pressure sensitive adhesive backing **34** to bond to the nonwoven web **30**, joining the two materials to form the female fastening component **22**. As used herein, the term "superpose" or "superposing" will refer to one layer of material having a particular geometric shape being laid upon another layer of material having a substantially similar geometric shape such that all like pans of the two layers of material substantially coincide.

The combining rolls **124** may take on any number of different configurations, as are known in the art. For example, the combining rolls **124** may have smooth surfaces or may have grooves, teeth or any patterns of indentations and/or raised areas on their surfaces. Further, the combining rolls **124** may be identical or may have different surface characteristics, as described above.

Once the nonwoven web **30** and the elastomeric adhesive backing **34** have been joined to form the female fastening component **22**, the laminate **90** is returned to a relaxed condition. In this configuration, the nonwoven web **30** will become gathered in at least the direction parallel to the path of response of the adhesive film **34**, which will form ridges, wrinkles, or furrows extending outwardly from the first surface **31** of the female component **22** capable of entangling the hooks **28** of a complementary male fastening component **24**. The elastomeric laminate **90** will be elastically extensible in the direction parallel to the path of response of the adhesive film **34** up to about the free length of the nonwoven web **30**.

Contracting the laminate **90** to a relaxed condition can be accomplished in a number of ways, including simply removing the laminate **90** from the tentering belts **135** and allowing it to contract. More preferably, however, as shown in FIG. **13**, the laminate **90** can remain adhered to the belts **140** and **142** as they travel from the diverging end **144** towards the converging end **146** of their cycle. As the belts **140** and **142** travel from the diverging end **144** toward the converging end **146**, the belts **140** and **142** converge, and thus contract the laminate **90**. (As used herein, the terms "converge" and "converging" mean to move closer together.) Alternatively, as shown in FIG. **11**, the laminate **90** may be removed from the belts **140** and **142** and transported to a separate configuration of converging belts **158**. Although the converging belts **158** may take on a number of different configurations, a detailed description of one preferred embodiment of the converging belts is described in the co-pending U.S. application Ser. No. 08/254,812, entitled "Apparatus For Continuously Stretching or Continuously Releasing Stretching Forces From A Web Using Two Pairs of Opposing Non-Planar Belts", filed on Jun. 6, 1994, in the names of L. John Viltro, et al. which is incorporated herein by reference.

After the laminate **90** is contracted, it is removed from either the tentering belts **135** or the converging belts **158**, leaving exposed the pressure sensitive adhesive of the second surface **33** of the adhesive backing **34**. The exposed surface may be used to bond the female fastening component **22** to an absorbent article or any other desired article, or may be deactivated by blocking as is commonly known in the art so that the adhesive of the elastomeric adhesive backing **34** does not bond to other materials through the pressure sensitive properties of the elastomeric adhesive backing **34**. Blocking is accomplished by an adhesive deactivation system (not shown) applying a powder of resin to the exposed face of the elastomeric adhesive backing **34**. Suitable resin powders include talcum powder, polyolefinic powders, and preferably a resin similar to that used for the nonwoven web **30**. Alternatively, the exposed face of the elastomeric adhesive backing **34** may be deactivated by applying a non-adhesive elastomeric film, nonwoven, foam or any other suitable non-adhesive material thereto. An example of one suitable non-adhesive elastomeric film is H2901 manufactured by Findley Adhesives Corporation of Wauwatosa, Wis.

Alternative Embodiments

One preferred alternative embodiment of the present invention for providing regions of differential stretch throughout the adhesive film **34**, as shown in FIG. **11**, comprises three tentering belts, a first belt **140*a***, a second belt **142*a***, and a third belt **143*a***. (As used herein, the term "differential stretch" refers to areas of the adhesive film **34** that have been unequally elongated.) As discussed above, spaced apart regions of the second surface **33** of the adhesive **34** are adhered to each of the tentering belts. In this particular embodiment, a first region **159*a*** of the adhesive film **34** is adhered to the first belt **140*a***, a second region **160*a*** of the adhesive film **34** is adhered to the second belt **142*a*** and a third region **161*a*** of the adhesive film is adhered to the third belt **143*a***. As the belts move in the machine direction, the first belt **140*a*** and the second belt **142*a*** diverge at a rate different from the rate at which the second belt **142*a*** and the third belt **143*a*** diverge, thus producing two regions of differential stretch in the adhesive film **34**.

Another preferred alternative embodiment, as shown in FIG. **12**, comprises a first pair **180** of tentering belts comprises belts **182** and **184**, and a second pair **185** of tentering belts comprises belts **187** and **189**. Each of said belts contacts a different spaced apart region of the second surface **33** of the adhesive film **34**. As the pairs of belts move in the machine direction, they diverge at different rates producing areas of differential stretch throughout the adhesive film **34**.

(Of course, the first pair **180** could comprise tentering belts **184** and **187** and the second pair **185** could comprise the tentering belts **182** and **189**.) Further, numerous other configurations are contemplated wherein some of the tentering belts diverge and others run parallel to each other, thus producing an adhesive film **34** having portions that are stretched between the diverging belts and other portions that are left unstretched between the parallel belts. (Although some preferred embodiments have been discussed, it should be noted that any number of tentering belts may be used to produce any combination or stretched and relaxed regions throughout the adhesive film **34**.)

Yet another alternative embodiment of the present invention provides a female fastening component **22** with multi-directional stretch. In this embodiment, the adhesive film **34** may be drawn through the nip formed between a pair of tensioning rolls (not shown). The tensioning rolls provide for machine direction stretching the adhesive film **34** prior to being applied to the tentering belts **135**, this provides a laminate which is elastically extensible in two directions, i.e., the machine direction and the cross machine direction. A laminate which is elastically extensible in the machine direction and methods of forming such a laminate are described in greater detail in U.S. Pat. No. 5,032,120, entitled "Disposable Absorbent Article Having Improved Leg Cuffs", issued Jul. 16, 1991, to Mary E. Freeland and Patrick J. Allen, which is incorporated herein by reference.

Method of Making a Tri-laminate Embodiment

The above-described method of producing a female fastening component comprising a single nonwoven web **30** joined to the first surface **31** of the elastomeric adhesive film **34** can also be used to produce a tri-laminate female fastening component comprising a nonwoven web **30**, joined to the first surface **31** of the backing **34** and a second lamina **80** joined to the second surface **33** of the backing **34**. As described above, the nonwoven web **30** and the backing **34** are joined to form the laminate **90**. However, when the laminate **90** exits the nip between combining rolls **124**, the exposed face of the adhesive backing **34** is not deactivated as described above. Rather, as shown in FIG. **14**, the laminate **90** is allowed to remain on the tentering belts **135** as the tentering belts **135** move from the diverging end **144** of their cycle toward the converging end **146** of their cycle. Alternatively, as is shown in FIG. **15**, the laminate **90** may be transported to the separate converging belts **158**. In either case, the laminate **90** may be partially or fully relaxed prior to application of a second lamina **80**.

The second lamina **80** is provided by the additional process module **113**, as is shown in FIGS. **14** and **15**. The second lamina **80** is taken from the unwind roll **150** and preferably passes through the S-wrap tensioning roll **152** to provide for proper tensioning and prevent puckering or bunching of the lamina **80**. Guide roll **156** guides the second lamina **80** into the combining rolls **162**. If necessary, a tracking system, not shown, as is commonly utilized and known in the art, may be employed in the process module **113** to optimally track and adjust the second lamina **80** into the combining rolls **162**.

After the laminate **90** comprising the nonwoven **30** and the elastomeric adhesive backing **34** exits the converging belts **158**, the second surface **33** of the adhesive backing **34** is brought into contact with the second lamina **80**. The laminate **90** and the second lamina **80** are passed through the nip of combining rolls **162** under sufficient pressure for the adhesive **34** to adhere to the lamina **80**, thus forming the tri-laminate female fastening component **100**.

In a preferred embodiment, the second lamina **80** is joined to the adhesive backing **34** after the laminate **90** has been at least partially, yet not fully relaxed. (This creates a tri-laminate with the characteristics and benefits described above with respect to one alternative embodiment of the present invention as shown in FIG. **6**.) Preferably, the second lamina **80** is joined to the adhesive backing **34** after the laminate **90** has been relaxed such that the lateral dimensions of the laminate **90**, after converging, is between about 90% and about 50% of the lateral dimensions of the lamina **22** when fully stretched. In an especially preferred embodiment, the second lamina **80** is joined to the adhesive backing **34** after the laminate **90** has been relaxed such that the lateral dimensions of the laminate **90**, after converging, is about 70% of the lateral dimensions of the laminate **90** when fully stretched. However, embodiments are contemplated wherein the second lamina **80** is joined after the laminate **90** is completely relaxed, or while the laminate **90** is fully stretched.

After the tri-laminate **100** has been formed, as described above, the tri-laminate **100** may be adhered to an absorbent article or any other desired object. The process of forming the tri-laminate **100** leaves exposed the portions of the second surface **33** that were adhered to the tentering belts **35**. Thus, the portions of the second surface **33** of the adhesive film that were adhered to the tentering belts **35** can be used to join the tri-laminate **100** to any desired object without the use of any additional adhesive.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended Claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. A method of manufacturing an elastomeric female fastening component capable of engaging a complementary male fastening component, the method comprising the steps of:

(a) providing a first lamina in a machine direction, said first lamina comprising an elastomeric, pressure-sensitive adhesive film having a first adhesive surface and a second adhesive surface opposed to said first adhesive surface, a relaxed orientation and an elongated orientation;

(b) contacting at least a first region of said second adhesive surface of said first lamina with a first belt to adhere said first region to said first belt and contacting at least a second region of second adhesive surface of said first lamina with a second belt to adhere said second region to said second belt, said first region being spaced apart from said second region; and

(c) diverging said first belt and said second belt such that said first lamina becomes stretched in a cross machine direction which is generally perpendicular to said machine direction said second adhesive surface being of such an adhesive nature that said film is retained on said belts during diverting without additional securing means, said first lamina being stretched from said relaxed orientation to said elongated orientation;

(d) contacting a second lamina comprising a nonwoven web with said first adhesive surface of said first lamina in said elongated orientation, thereby joining said second lamina and said first lamina to form a laminate; and

(e) relaxing said first lamina such that said second lamina is shirred to form catching regions capable of entangling the hooks of a complementary male fastening component.

2. The method of claim 1 wherein said elastomeric adhesive is extruded onto a release surface to form said first lamina.

3. The method of claim 2 wherein said release surface comprises a forming belt.

4. The method of claim 1 comprising two diverging belts.

5. The method of claim 4 wherein said belts rotate continuously about at least a pair of pulleys, one of such pulleys defining a converging end and the other pulley defining a diverging end.

6. The method of claim 5 wherein step (e) of relaxing said laminate comprises allowing said first region and second region of said first lamina to remain adhered to said first belt and said second belt as said belts move from said diverging end toward said converging end, thereby converging said laminate.

7. The method of claim 1 comprising a multiplicity of belts.

8. The method of claim 7 wherein said multiplicity of belts comprises at least a first belt, a second belt, and a third belt, wherein said first region of said second surface of said first lamina contacts said first belt, said second region contacts said second belt and a third region contacts said third belt, said first belt diverging from said second belt at a rate different from the rate at which said second belt diverges from said third belt so as to produce regions of differential stretching in said first lamina.

9. The method of claim 7 wherein said multiplicity of belts comprises at least a first pair of belts and a second pair of belts, each of said belts contacting a different spaced apart region of said second surface of said first lamina, wherein said first pair of belts diverges at a different rate than said second pair of belts so as to produce regions of differential stretching in said first lamina.

10. The method of claim 7 wherein said multiplicity of belts comprises at least a first pair of diverging belts and at least one pair of parallel belts, each of said belts contacting a different spaced apart region of said second surface of said first lamina so as to stretch said first lamina between said diverging belts and allow said first lamina to remain relaxed between said parallel belts.

11. A method of manufacturing an elastomeric female fastening component capable of engaging a complementary male fastening component, the method comprising the steps of:

(a) providing a first lamina in a machine direction, said first lamina comprising an elastomeric, pressure-sensitive adhesive having a first adhesive surface and a second adhesive surface opposed to said first adhesive surface, a relaxed orientation, and an elongated orientation, and a path of response along which said lamina contracts from said elongated orientation to said relaxed orientation;

(b) contacting a first region of said second adhesive surface of said first lamina with a first belt to adhere said first region to said first belt and contacting at least a second region of second adhesive surface of said first lamina with a second belt to adhere said second region to said second belt, said first region being spaced apart from said second region; and

(c) diverging said first belt and said second belt such that said first lamina becomes stretched in a cross machine direction which is generally perpendicular to said machine direction, said first lamina being stretched from said relaxed orientation to said elongated orientation;

(d) contacting a second lamina comprising a nonwoven web with said first adhesive surface of said first lamina in said elongated orientation, thereby joining said second lamina with said first lamina to form a laminate;

(e) partially relaxing said first lamina such that said second lamina is shirred to form catching regions capable of entangling the hooks of a complementary male fastening component; and

(f) placing a third lamina in contact with said second adhesive surface of said first lamina while in said partially relaxed state thereby joining said third lamina to said first lamina to form a laminate.

12. The method of claim 11 wherein said elastomeric adhesive is extruded onto a release surface to form said first lamina.

13. The method of claim 12 wherein said release surface comprises a forming belt.

14. The method of claim 11 comprising two diverging belts.

15. The method of claim 11 comprising a multiplicity of belts.

16. The method of claim 15 wherein said multiplicity of belts comprises at least a first belt, a second belt, and a third belt, wherein said first region of said second surface of said first lamina contacts said first belt, said second region contacts said second belt and a third region contacts said third belt, said first belt diverging from said second belt at a rate different from the rate at which said second belt diverges from said third belt so as to produce regions of differential stretching in said first lamina.

17. The method of claim 15 wherein said multiplicity of belts comprises at least a first pair of belts and a second pair of belts, each of said belts contacting a different spaced apart region of said second surface of said first lamina, wherein said fast pair of belts diverges at a different rate than said second pair of belts so as to produce regions of differential stretching in said first lamina.

18. The method of claim 15 wherein said multiplicity of belts comprises at least a first pair of diverging belts and at least one pair of parallel belts, each of said belts contacting a different spaced apart region of said second surface of said first lamina so as to stretch said first lamina between said diverging belts and allow said first lamina to remain relaxed between said parallel belts.

19. The method of claim 14 wherein said belts rotate continuously about at least a pair of pulleys, one of such pulleys defining a converging end and the other pulley defining a diverging end.

20. (Amended) The method of claim 19 wherein step (e) of relaxing said laminate comprises allowing said first region and second region of said first lamina to remain adhered to said first belt and said second belt as said belts move from said diverging end toward said converging end, thereby converging said laminate.

21. The method of claim 11 wherein step (c) comprises partially relaxing said first lamina such that said first lamina is caused to contract along said path of response to between about 50 percent and about 90 percent of said elongated orientation.

22. The method of claim 11 wherein step (e) comprises of partially relaxing said first lamina such that said first lamina is caused to contract along said path of response to between about 60 percent and about 80 percent of said elongated orientation.

23. The method of claim 11 wherein step (e) comprises of partially relaxing said first lamina such that said first lamina is caused to contract along said path of response to about 70 percent of said elongated orientation.

24. The method of claims 1 or 11 further comprising the steps of elongating said first lamina in said machine direc-

tion prior to step (d) which includes contacting a second lamina with said first adhesive surface of said first lamina to form a laminate, such that said laminate is elastically extensible in said machine direction and at least one other direction.

25. The method of claim 1 further comprising step (f) placing a third lamina in contact with said second adhesive surface of said first lamina, thereby joining said third lamina to said first to form a laminate.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,547,531

DATED : August 20, 1996

INVENTOR(S) : ALLEN, ET AL.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, line 20, "clothing disposable" should read --clothing, disposable--.

Column 1, line 50, "can he easily" should read --can be easily--.

Column 2, line 25, "6hers" should read --fibers--.

Column 3, line 32, "backing, The" should read --backing. The--.

Column 3, line 34, "is in it" should read --is in an--.

Column 3, line 45, "comprising the steps" should read --comprising the steps of:--.

Column 4, line 17, "view or" should read --view of--.

Column 4, line 17, "component or" should read --component of--.

Column 5, line 9, "pluraity or" should read --plurality of--.

Column 5, line 51, "imply" should read --simply--.

Column 6, line 30, "filaments 35" should read --filaments 36--.

Column 7, line 20, "COP-OVON" should read --COROVON--.

Column 7, line 21, "Cotoran" should read --Corovin--.

Column 7, line 58, "On general" should read --(In general--.

Column 9, line 37, "shirting" should read --shirring--.

Column 9, line 59, "which ate" should read --which are--.

Column 10, line 37, "a "lap joint", (The" should read --a "lap joint". (The--.

Column 10, line 50, "remains in" should read --remains intact.--.

Column 11, line 1, "S5" should read --85--.

Column 11, line 25, please place quotation marks around the words "partially relaxed".

Column 11, line 57, "knob" should read --known--.

Column 12, line 36, "previous" should read --pervious--.

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DATED : August 20, 1996

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It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 13, line 22, "ere" should read --are--.

Column 13, line 30, "Well" should read --Weil--.

Column 13, line 61, "Form" should read --form--.

Column 14, line 12, "11.4" should read --8.4--.

Column 14, line 35, "tenterlag" should read --tentering--.

Column 14, line 44, "tenterlag" should read --tentering--.

Column 14, line 57, "Co, of" should read --Co. of--.

Column 15, line 31, "Corpotation" should read --Corportion--.

Column 15; line 42, "pans" should read --parts--.

Column 17, line 5, "tun" should read --run--.

Column 17, line 11, "combination or" should read --combination of--.

Column 20, line 32, "fast" should read --first--.

Signed and Sealed this

Twentieth Day of May, 1997

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks